

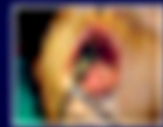
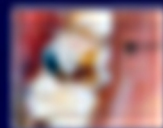
Second Edition
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Principles and Practice of **PEDODONTICS**

Arathi Rao



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***Principles and Practice
of
PEDODONTICS***

Principles and Practice of PEDODONTICS

Second Edition

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FOREWORD

I am pleased to write the foreword for the second edition of the book titled *Principles and Practice of Pedodontics* by Dr Arathi Rao. The previous edition of this book has done extremely well and has fulfilled the need for a concise and comprehensive book as reflected by its enormous popularity.

The second edition is a brilliant upgrade; with extensive illustrations and an additional chapter on Medical Emergencies in Dental Clinic, which is vital for the practice of dentistry.

I would like to congratulate the author for bringing out the second edition in such a short span of time, I wish her good success in all her endeavours.

V Surendra Shetty MDS
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PREFACE TO THE SECOND EDITION

Hello readers, I hope the first edition was very informative and thank you for that immense support. As is always, betterment and continual improvement should be ones goal. Keeping this in mind, I have tried to gather all the shortcoming of the first edition and improvised on this second edition.

The second edition comprises of 31 chapters, designed in a way that makes it easier to understand by an undergraduate student of Pedodontics and Preventive Dentistry.

Additional chapter “Medical Emergencies in Dental Clinic” has been included in this edition. Understanding and management of such emergencies is very essential in day-to-day practice of dentistry for children.

Illustrations in the second edition are plenty making it easier to understand and remember. There are about 610 beautiful and practically helpful photographs which I am sure will make reading easy and very interesting.

Extra references are included as ‘Further Reading’ for those with an extensive thirst for knowledge.

Arathi Rao

PREFACE TO THE FIRST EDITION

Pedodontics has always been a subject which is interesting but very vast. It is very difficult to find a book that is complete and suited for the undergraduate students, which is comprehensive, yet easy to understand. I have tried to cover all the topics in compliance with the syllabus of various universities in a very easy to understand way with adequate illustrations. Some extra useful information is given in separate boxes which makes it easy to read and remember. This book is aimed at helping the undergraduate students to have a better knowledge of Pedodontics and to reproduce the same during the exams.

I would request the readers to send their valuable suggestions and advice to me.

Arathi Rao

ACKNOWLEDGEMENTS

First and the foremost I would like to thank the students all over the country and abroad who have read and appreciated the first edition of my book. Hope you will find the second edition too very informative.

My sincere thanks to my Dean, Dr V Surendra Shetty who has been my continuous source of inspiration.

I also would acknowledge the support given to me by the Management and Officials of Manipal University, Manipal.

My dear guide Dr Subrato Sarkar, is a very good human being. I am greatly indebted for all his encouragement and guidance during my postgraduate period and thereafter also.

I thank all the contributors of my book, Dr Sumanth, Associate Professor, Oral Medicine and Radiology, Dr Deepa, Associate Professor, Periodontics, Dr Ashwin Rao, Assistant Professor, Pedodontics and Dr Ramya Shenoy, Assistant Professor, Community and Preventive Dentistry, Manipal College of Dental Sciences, Mangalore.

I show my appreciation to the help given to me by Dr Karen Boaz, Associate Professor Dept. of Oral Pathology and Dr Latha Prabhu, Professor and Head, Dept. of Anatomy, Kasturba Medical College, Mangalore.

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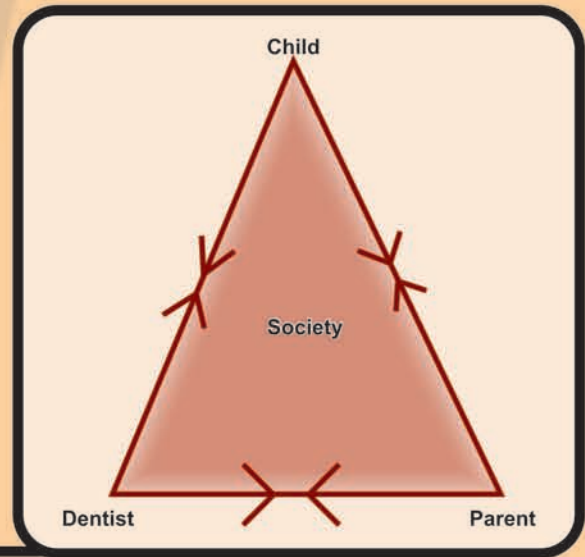
Special thanks to Dr Jyostna Rimal, Dr Aarthi Bhat, Dr Saptharshi Bhowal, Dr Rashmi C, Dr Ramya S, and Dr Sankalp Taparia and staff of Department of Pedodontics and Preventive Dentistry, Manipal College of Dental Sciences, Mangalore for their help with a cheerful and happy attitude.

I would like to dedicate my book to my parents Dr K Nagesh Rao, Prof. and Head, Dept. of Anatomy, A J Institute of Medical Sciences, Mangalore and Mrs Usha N Rao. I love my sister Dr Ashwini Rao, Prof and Head, Dept. of Community Dentistry, Manipal College of Dental Sciences, Mangalore who has also contributed many chapters in this book and her lovely daughter Kaavya. I thank my husband Rajesh Nandavar for supporting and helping me complete my book effortlessly. Last but not the least for whom my whole life is dedicated, Arjun my wonderful son without whom there is no meaning to my life.

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Chapter 1



Introduction

1. Definitions of Pediatric Dentistry
2. Pedodontics in India
3. Aims and Objectives of Pediatric Dental Practice
4. Scope of Pedodontics
5. Specific Differences Between Child and Adult Patients
6. General Principles of Pediatric Pharmacology
7. Responsibilities of the Pedodontist



2 Principles and Practice of PEDODONTICS

A young child is definitely more than just a miniature adult. Managing and convincing a child as a patient for any dental procedure requires extra effort. Pedodontists as specialists should master these skills and be in a position to manage children. It is a challenging venture where only few dare to go.

Pediatric dentistry as it is also referred to, in the beginning was mainly concerned with extraction and restorations. The trend changed from extractions to preservation. Presently the concept of pediatric practice is prevention and concentrating on minimal invasion.

Pedodontist is in an excellent position to alter the growth pattern and improve the resistance to diseases, as he or she deals with children during their formative periods.

DEFINITION OF PEDIATRIC DENTISTRY

According to Stewart, Barber, Troutman and Wei (1982)

“Pediatric dentistry is the practice and teaching of comprehensive preventive and therapeutic oral health care of child from birth through adolescence. It is constructed to include care for special patients who demonstrate mental, physical or emotional problems”.

According to the American Association of Pediatric Dentistry (1999)

“Pediatric dentistry is an age defined specialty that provides both primary and specialty, comprehensive, preventive and therapeutic oral health care for infants and children through adolescence including those with special health care needs”.

- First textbook describing the dental problems and management for children was published in the year 1924.
- The American Society for the Promotion of Dentistry for Children was established at Detroit in the year 1927. The name was later changed to American Society of Dentistry for children in the year 1940.
- The American Academy of Pedodontics was started in the year 1947 and later in the year 1984 was changed to American Academy of Pediatric Dentistry.

PEDODONTICS IN INDIA

1. First dental college began as “Calcutta Dental College and Hospital in the year 1920, by Dr R Ahmed which was later renamed as Dr R Ahmed Dental College and Hospital.
2. Initially pedodontics as a subject was combined with orthodontics and only in the year 1978 was introduced as a separate subject for undergraduates.
3. Pedodontics became a separate specialty much before it was introduced as a separate subject for the undergraduates in the year 1950 at Government Dental College, Amritsar.
4. Indian Society of Pedodontics and Preventive Dentistry began functioning in the year 1979.

AIMS AND OBJECTIVES OF PEDIATRIC DENTAL PRACTICE

1. The services rendered to the child must be focused from the point what is best of the child at that moment and also for the adult into whom the child will eventually grow.
2. The child should be treated as a whole. Effort must be made for the general and oral health to be in accordance with each other.
3. Prevention of oral diseases must be the prime motive and should begin if possible from before the birth, directing the expectant mothers.
4. Educating parents regarding importance of deciduous teeth, dental treatment and preservation of teeth.
5. Developing dentition and jaws should be observed regularly so that any developing malocclusion can be intervened at the right time.
6. Relief of pain and sepsis forms one of the main theme of a care provider.
7. To achieve and maintain esthetics.
8. Improving personal information data bank is very important and can be done thorough updating of both clinical and theoretical knowledge on an regular basis.



SCOPE OF PEDODONTICS

1. Pedodontics encompasses a variety of disciplines, techniques, procedures and skills, all which are aimed, adapted and targeted to achieve healthy oral health to children.
2. Pediatric dentistry is an age specific specialty and not a technique specific or disease specific specialty.
3. Since it deals with children, pedodontist is in an excellent position to monitor growth and accordingly deal with the arising problems.
4. Pediatric dentists have extended services to fulfill the needs of the special child, including physically, medically and mentally handicapped.
5. They also form team members in the management of cleft lip and palate patients.

SPECIFIC DIFFERENCES BETWEEN CHILD AND ADULT PATIENTS

Child is in a dynamic state of growth and development and is thus a changing person.

Three general areas in which pediatric patients are unique compared to the adults are:

1. Physiologic and anatomic differences
2. Pharmacokinetics
3. Emotional differences

Physiologic and Anatomic Differences

These differences can be discussed based on body size, body fluids, respiratory system, cardiovascular system and the urinary system.

Body Size

- i. Less drug is needed to reach an effective plasma level but less is also needed to produce toxicity in children due to small body size.
- ii. Height and weight of children are less than that of adults, their proportions also differ from adults.
- iii. Ratio of body surface area (BSA) to body weight is about seven times greater for neonates than for adults. Many physiologic functions are proportional to BSA, which may be the reasons why some professionals advocate the use of body surface area.

- iv. Smaller the patient, the higher is the basal metabolic rate, oxygen consumption and fluid requirement per hour.

Child's weight increases by about 20 times from birth to adulthood and height increases only about 3½ times.

Body Fluids

- i. Children have larger volume of total body water (TBW). Child's TBW is 80% of body weight and that of an adult's is 50-60%. This has direct bearing on pharmacokinetics of water soluble medications. Because these drugs are distributed to a relatively larger volume once absorbed, a larger dose is necessary to achieve therapeutic effect in a small child.
- ii. Total body fat also varies.

Fat content in a premature infant is about 1% of the body weight, whereas a full term infant's body fat is about 16% of the body weight. In an one-year-old it forms 22% of body weight, four-year-old 12% and in 10-11 years it forms 18-20% of body weight.

The child with the smaller percentage of body fat thus requires a smaller dose of a lipid soluble drug. Lipid soluble drugs such as barbiturates and diazepam may require higher dosage in an obese child as most of it will be distributed to fat tissues, therefore decreasing their effective plasma levels.

Respiratory System

- i. Relatively large head, narrow nasal passage, smaller diameter of glottis and trachea predisposes the child to increased risk of airway obstruction. Tongue is proportionally larger, larger mass of lymphoid tissues, more copious secretions and loose glottic areolar tissue further compromises the airway. This makes it difficult to manage the child during sedation, general anesthesia or respiratory emergency.
- ii. In a child smaller bony thorax and soft sternum, provides a less stable base for the ribs and intercostal muscles. Ribs are more horizontal than in adults and do not allow as much chest



4 Principles and Practice of PEDODONTICS

expansion as do the more vertically curved adult ribs.

- iii. A child cannot compensate as readily as an adult by increasing ventilatory volumes by increasing chest expansion. So a child is more dependent on the diaphragm as the primary muscle of respiration. Thus care should be taken not to impede diaphragm movement, which might occur when the child is made to lie supine or with head low because the abdominal contents will place gravitational forces on the diaphragm
- iv. Respiratory rate of the child is higher due to higher metabolic rate.
- v. Basal metabolic rate (BMR) in children is double that of an adult thus requiring greater oxygen consumption and carbon dioxide production.

Respiration rate

Newborn—30-60/min
1 year—20-35/min
5 years—20-25 /min
15 years—15-20 /min
Adult—12-20/min

Cardiovascular System

- i. Relative blood volume in children is greatest at birth and decreases with age.
In a newborn it is 85 ml/kg and in adult it is 70 ml/kg.
- ii. Heart rate is highest in infants.
- iii. Parasympathetic tone (vagal) is more pronounced in infants due to immaturity of sympathetic nervous system. Any vagal stimulation may cause a decrease in heart rate, as seen with manipulation of the airway (endotracheal intubation), bladder distension and pressure on eyes. For these reason children undergoing treatment under general anesthesia should be given parasympathetic blockers such as atropine.
- iv. In a newborn peripheral circulation is very much poorly developed. This is important as uptake of intramuscular injections are low.
- v. About 40% of the cardiac output in children contributes to the cerebral blood flow, compared to only about 29% in adult.

Heart rate

Newborn—115-170/min
1 year—90-135/min
5 years—80-120/min
15 years—70-100/min
Adult—70/min

Systolic blood pressure

Newborn—60-75 mmHg
1 year—96 mmHg
5 years—100 mmHg
15 years—120 mmHg
Adult—120-125 mmHg

Urinary System

- i. Level of urine concentration by the kidneys is very much low in neonates. Therefore infants require more free water per day. Infant and young child may become rapidly dehydrated.
- ii. Glomerular filtration rate (GFR) of an infant is 30-50% of an adult which may be due to less mature glomeruli and lower blood pressure. So drugs that are excreted primarily by glomerular filtration have longer half lives (upto 50% longer) in a child. Example of such drugs are aminoglycoside antibiotics, digoxin and curare. GFR reaches adult level by 3-6 months.
- iii. Tubular reabsorption and tubular secretion also vary and mature to adult levels during the first few months of life.

Pharmacokinetics

It is a dynamic process of drug turnover in the body, which includes absorption, distribution, biotransformation and elimination. It determines a drugs plasma concentration, duration of action and its effectiveness and toxicity.

Factors affecting kinetics of drug

Dose and form of the drug, plasma protein binding, ionization, lipid solubility, rate of metabolism and volume of distribution.

Uptake of the Drug and Absorption

- i. Pulmonary uptake of nitrous oxide is more rapid in infants due to higher cardiac output, good alveolar ventilation and higher percentage of richly perfused visceral tissues.



- ii. Topical medications are absorbed more rapidly and completely in children, due to greater permeability and relatively inactive sebaceous glands.
- iii. Gastric emptying time in a newborn is 6-8 hours compared to 2 hours in an older child and adult. Younger children have a lower gastric pH, promoting greater absorption of weakly acidic drugs such as penicillin, while delaying absorption of weakly basic drugs such as diazepam and theophyllin. Irregular peristalsis slows down the transit time in the bowel in young infants causing net effect of slower drug absorption. Active transport mechanisms in the bowel mucosa aiding in drug absorption is deficient in infants.

Drug Distribution

- i. Neonates and infants have decreased plasma protein concentration especially albumin. This reduces the binding sites of the drug and they remain unbound or in the free form making it available to produce its pharmacological effect. Drugs that are highly protein bound, displace other protein bound drugs. Compounds like bilirubin, Sulfonamides, vitamin K are known to displace protein bound bilirubin leading to hyperbilirubinemia and resultant kernicterus (brain damage).
- ii. Drugs penetrate blood-brain barrier more easily in children than in adults, due to lack of myelination of the nervous tissue and greater membrane permeability. This can be advantages, when it is needed for the antibiotics to reach the CNS, but may be disadvantages owing to the greater sensitivity to CNS depressant like narcotics.
- iii. Children require higher concentration of inhalation anesthetics due to decreased receptor site sensitivity to drug. This sensitivity changes with the child's development. Other than this notable exception, children are more sensitive and are therefore more prone to drug toxicity.

Drug Metabolism

- i. In children liver enzyme production that is responsible for biotransformation of drugs may

be almost absent, reduced or even overproduced at various stages of development.

- ii. Poor oxidative rates in infants results in prolonged effects of diazepam, phenytoin and other drugs.
- iii. Poor conjugation results in prolonged effects of amphetamines and phenacetin.
- iv. Low levels of glucuronyl transferase in newborn, results in an inability to detoxify the antibiotic chloramphenicol, morphine and steroids and thus increasing their sensitivity. Glucuronyl transferase reaches normal levels by 1 month of age.
- v. Pseudocholinesterase levels are only 60% of normal for several months after birth.

Drug Excretion

At birth, the ability of the kidneys to clear drugs and concentrate urine is greatly reduced leading to prolongation of the effects of drug that are primarily excreted by the kidneys such as ampicillin, etc.

Emotional Differences

- a. The major difference between the treatment of children and an adult is the treatment relationship. Treatment relationship between the dentist and the adult patient is one to one whereas in case of a child patient there is a one to two relationship, with the child being the focus of attention of the dentist as well as the parent. This is represented by the pedodontic treatment triangle as given by Wright (Figs 1.1 and 1.2). The child occupies the apex of the triangle and is the focus of attention of both the dentist and the parent. All the three are interrelated. Recently society has been added, meaning that the influence of the society on the child has to be considered affecting the treatment modalities.
- b. Children exhibit a fear of the unknown.
- c. They do not know to rationalize.
- d. Behavior management modalities differ, depending on the age and understanding.
- e. Children have less concentration time. Therefore, treatment time should be restricted to not more than 20-30 minutes.

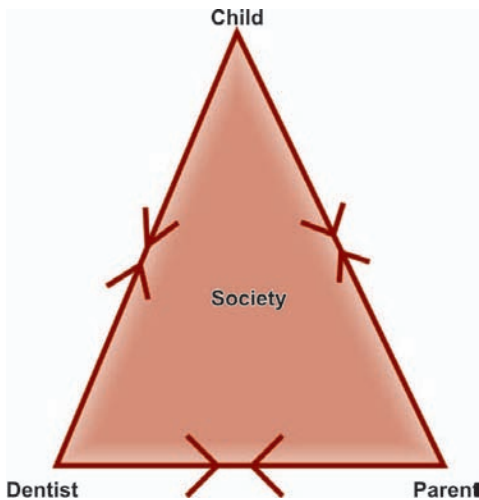


Fig. 1.1: The pedodontic treatment triangle



Fig. 1.2: Operatory area where the positioning of the child, operator and the parent resembles triangle and helps in proper communication

- f. Treatment appointments should be preferably given during the morning time and avoided during their nap time.
- g. Adult patient seeks treatment by his own will, but the child patient visits the dentist usually by the will of his parents.

GENERAL PRINCIPLES OF PEDIATRIC PHARMACOLOGY

1. The metric system, rather than apothecary system should be used to determine dosage. Instead of 1 tablespoon, 15 ml is preferred.
2. Younger the patient, the more atypical the therapeutic and toxicological response to drug therapy.
3. In older patients the depth of anesthesia is more profound compared to the younger children.
4. Respiratory alkalosis, the initial stage of salicylate intoxication seen in older children and adults is rare or short lived in infants.
5. Immaturity in blood-brain barrier or differences in enzymatic degradation of drugs may account for age dependent variations in response.
6. The younger the child, the more atypical is the disease manifestations.
7. In infants seizures are characterized only by limpness or apnea. Motor seizures appear as limited tonic stiffening or partial movement of the face and limbs.
8. True petit mal epilepsy is rare before 2 years and after 20 years.
9. Prolonged therapy with agents that affect the endocrine system retards the growth. Large doses of corticosteroids retard growth.
10. Excessive use of syrups and elixers containing sugar, damage teeth and should be avoided especially at night.
11. During nitrous oxide sedation, oxygen supply should be maintained at least at 20% and not less.
12. Allergenicity is greatest during childhood in less than 15 years of age.
13. Tetracycline should be used sparingly and preferably not used in children less than 8 years old.
14. Dosage rules such as Young's, Cowling's, Catzel's or Clark's rule should be followed. For anesthesia Young's or Clarke's rule is used.

Young's formula:

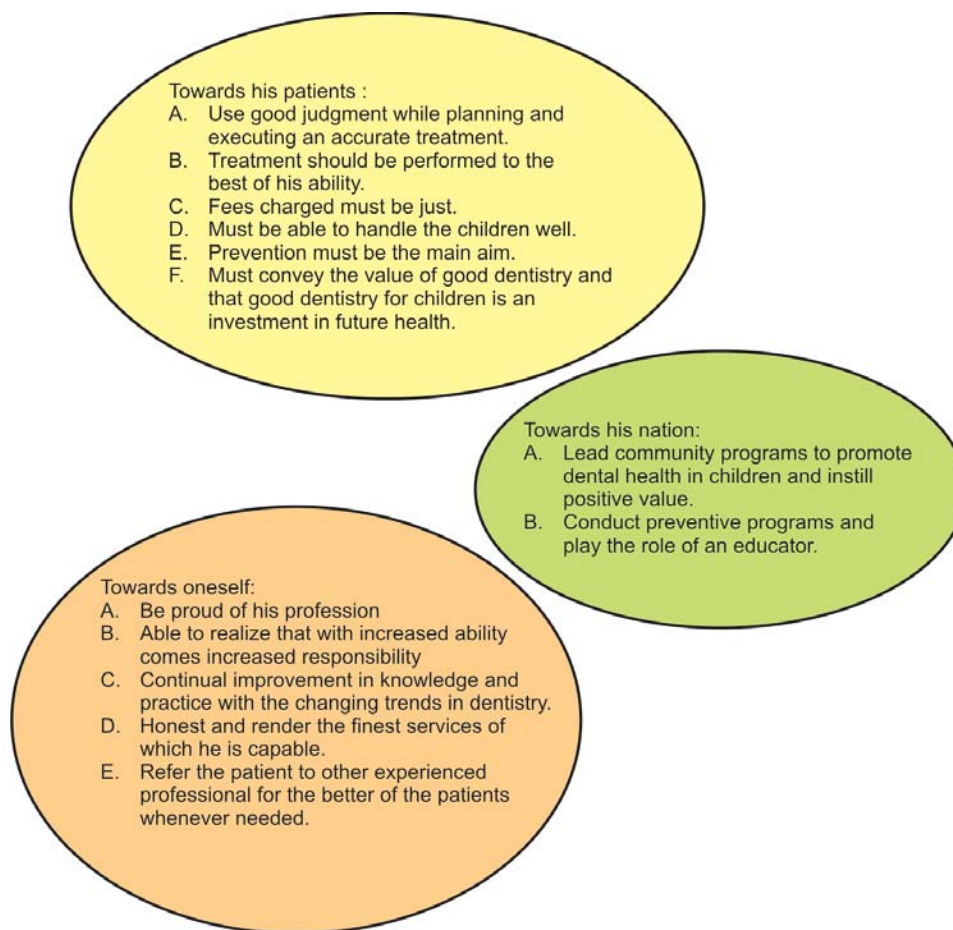
$$= \frac{\text{Age} \times \text{Adult dose}}{\text{Age} + 12}$$

Clarke's formula:

$$= \frac{\text{Body wt (kg)} \times \text{Adult dose}}{150}$$



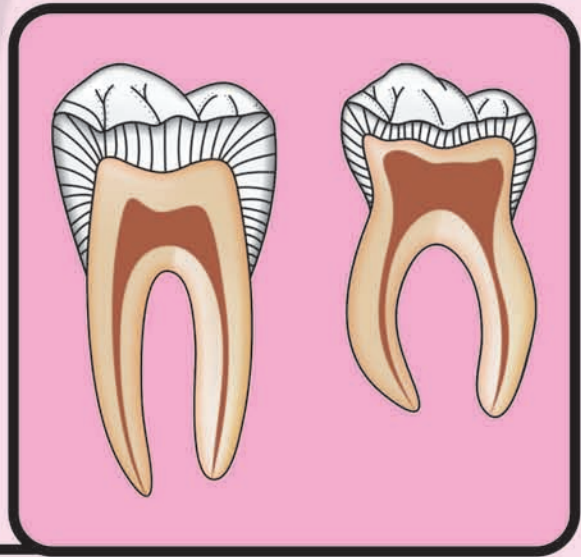
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Chapter 2



Morphology of Deciduous Teeth

1. Introduction
2. Difference Between the Deciduous Tooth and a Permanent Tooth
3. Morphology of Maxillary Incisors
4. Morphology of Mandibular Incisors
5. Morphology of Maxillary Canines
6. Morphology of Mandibular Canines
7. Morphology of Maxillary First Molars
8. Morphology of Mandibular First Molars
9. Morphology of Maxillary Second Molars
10. Morphology of Mandibular Second Molars
11. Practical Application of Understanding Tooth Morphology



INTRODUCTION

Studying tooth morphology includes understanding the shape, configuration and parts of a tooth. It is very important for clinical application during performing various procedures. Cavity preparations must conform to the thickness of enamel and dentin, keeping in mind the location and size of the pulp. Restoration of natural contours and morphology of deciduous teeth is needed for function, which can be achieved only with a good knowledge of tooth morphology.

DIFFERENCES BETWEEN A DECIDUOUS TOOTH AND A PERMANENT TOOTH (FIG 2.1)

Features of a Deciduous Crown

1. The crown of the deciduous tooth is shorter than the permanent tooth.
2. The occlusal table of a deciduous tooth is narrower labiolingually than is the permanent tooth.
3. The deciduous tooth is constricted in the cervical portion of the crown than is the permanent tooth.
4. The enamel and dentin layers are thinner in the deciduous tooth.
5. The enamel rods in the gingival third extend in a slightly occlusal direction from the dentinoenamel junction in deciduous teeth but extend slightly apically in the permanent dentition.
6. The contact areas between the deciduous molars are very broad and flat.
7. The color of the deciduous tooth is lighter than permanent teeth. The refractive index of milk is similar to deciduous tooth enamel. Hence the teeth are termed as milk tooth.

Features of a Deciduous Pulp

1. The pulp of the deciduous tooth is larger than that of the permanent tooth in relation to the crown size.
2. The pulp horns of the deciduous tooth (especially the mesial horns) are closer to the outer surface of the tooth than are those of the permanent tooth.
3. The mandibular molar has larger pulp chambers than does the maxillary molar in the deciduous tooth.
4. The form of the pulp chamber of the deciduous tooth follows the surface of the crown.

5. Usually there is a pulp horn under each cusp.
6. Thin and slender roots pulp canals, thin pulp canals
7. Accessory canals extend from floor of the pulpal chamber to the furcation or interradicular area.
8. Increased blood supply, due to which the deciduous pulp exhibits typical inflammatory response.
9. Responds by inflammatory process, resulting in increased internal resorption.
10. Reduced sensitivity to pain due to less number of nerve fibers.
11. Increased reparative dentin formation.
12. Poor localization of infection and inflammation.
13. Multiple ramification, making complete debridement impossible.
14. Ribbon shaped root canal (hour glass appearance) that is narrower mesiodistally, discourages gross enlargement of the canal.

Features of a Deciduous Root

1. The root of the deciduous anterior tooth is narrower mesiodistally than is that of the permanent anterior tooth.
2. The roots of the posterior deciduous tooth are longer and more slender in relation to crown size than are those of the permanent tooth.
3. The roots of the deciduous molar flare more as they approach the apex (which affords the necessary room for the development of the permanent tooth buds) than do the permanent molar roots.

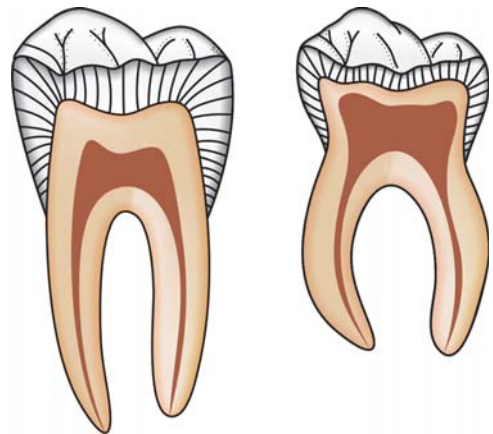


Fig. 2.1: Longitudinal section of a permanent and deciduous tooth



MORPHOLOGY OF INDIVIDUAL DECIDUOUS TEETH

Maxillary Incisors (Figs 2.2 and 2.3)

- The maxillary central and lateral incisors usually erupt by 7-8 months of age.
- The deciduous maxillary central incisor is unique in that it is the only tooth in the human dentition that has a greater mesiodistal dimension than crown height.
- The contact points with adjacent teeth are broad, extending from the incisal one-third to the gingival one-third.
- Labial surface is flat.
- There is a prominent lingual cingulum.
- The root is conical and roughly two and a half times as long as the crown height.
- *Anatomy of the pulp:* The central incisor has two or three small projections (pulp horns) toward the incisal edge. The mesial pulp horn is most prominent. The pulp horn is approximately 2.3 - 2.4 mm from the incisal edge and about 1.2 mm from the dentino-enamel junction (DEJ).
- The maxillary lateral incisor is smaller than the maxillary central incisor. The distal incisal aspect is rounded. The crown and root are more conical. The pulp chamber is smaller and is about 2.6 mm from the incisal edge and approximately 0.9 mm from the DEJ.

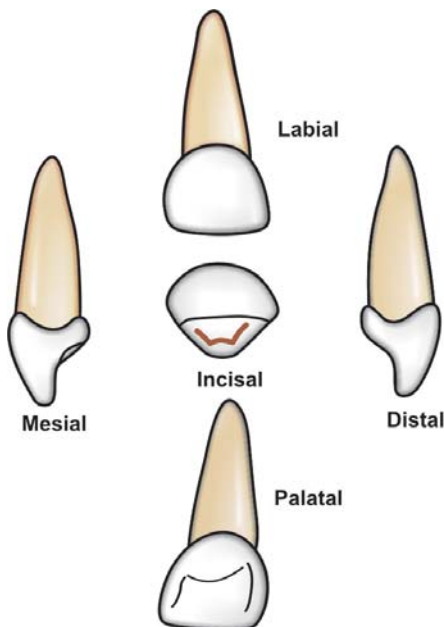


Fig. 2.2: Maxillary central incisor

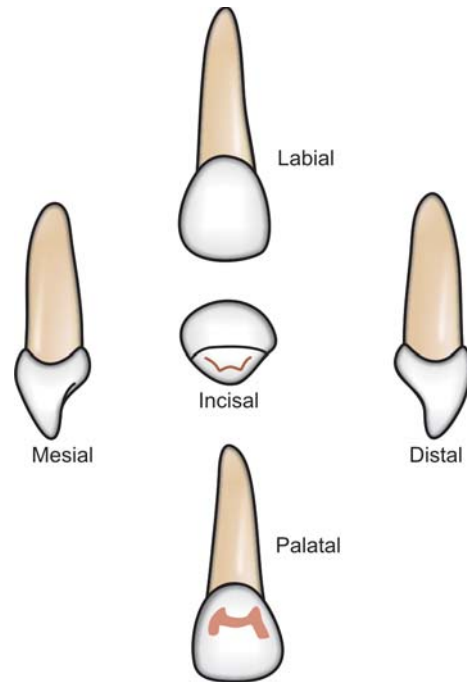


Fig. 2.3: Maxillary lateral incisor

Mandibular Incisors (Figs 2.4 and 2.5)

- These teeth are the first to erupt into the oral cavity at about 6 to 7 months of age.
- The mandibular central incisor is almost flat when viewed from the labial aspect.
- There are no developmental grooves or mammelons.
- The crown is one-third the length of the root with a cingulum on the lingual surface.
- The root is long and cylindrical.
- *Anatomy of the pulp:* The pulp canal follows the outline form of the surface topography of the primary mandibular central and lateral incisors. The pulp is approximately 2.6 mm from the incisal edge in the primary central incisor. The pulp of the mandibular lateral incisor has similar dimensions but is somewhat smaller.
- The primary mandibular lateral incisor is distinguished from the mandibular central incisor by the disto-incisal angle, which is more rounded. In overall dimensions, the primary lateral incisor is somewhat longer but narrower than the primary central incisor.

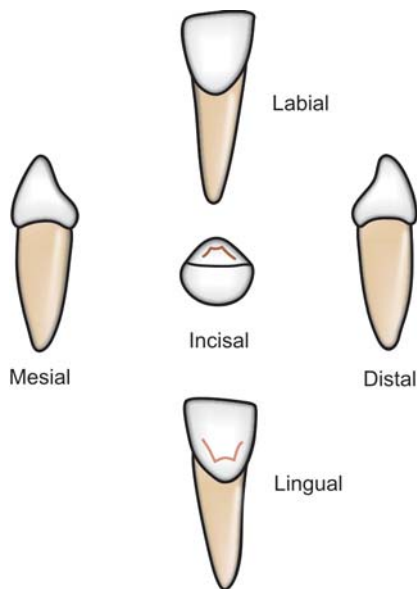


Fig. 2.4: Mandibular central incisor

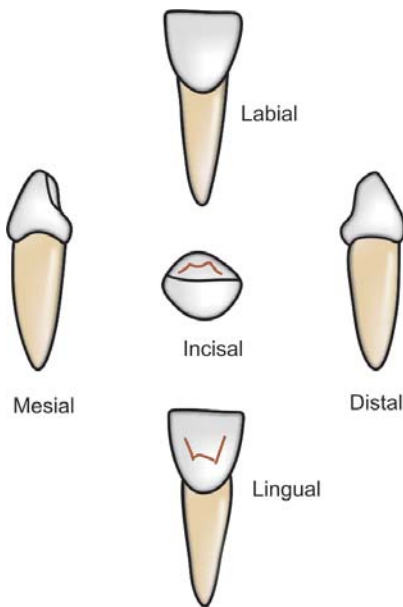


Fig. 2.5: Mandibular lateral incisor

The Maxillary Canines (Fig. 2.6)

- They erupt at about 18 months of age
- It is best described as being long and sharp.
- The crown is constricted at the cemento-enamel junction.

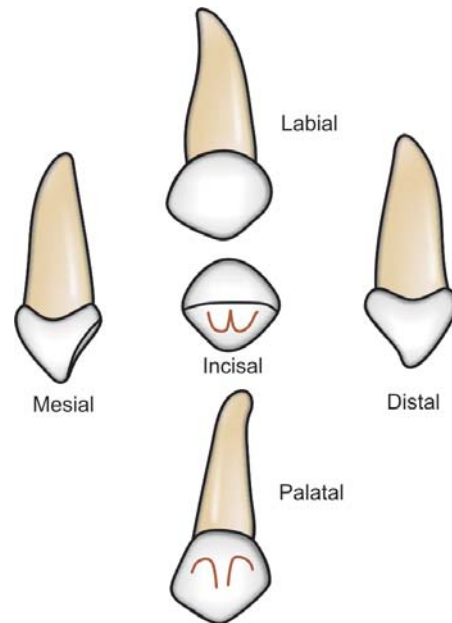


Fig. 2.6: Maxillary canine

- The marginal ridges on the primary canines are usually less distinct, but there is often a prominent cingulum.
- The long slender root is more than twice the crown length.
- *Anatomy of the pulp:* The pulp chamber follows the general contour of the tooth. The pulp horn is 3.2 mm from the cuspal tip.

The Mandibular Canines (Fig. 2.7)

- The mandibular canines erupt at about 16 months of age
- It is a long narrow tooth, much smaller than the primary maxillary canine.
- The distal marginal ridge is much lower than the mesial marginal ridge.
- The point of contact is very close to the cervical third of the tooth.
- The root is long and slender and is about twice the crown length.
- *Anatomy of the pulp:* The pulp chamber follows the general outline of the tooth form. The pulp is 3.0 mm from the cuspal tip.

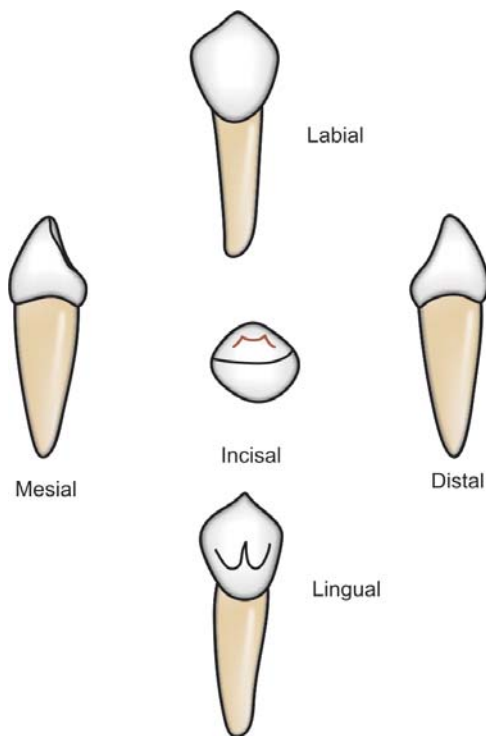


Fig. 2.7: Mandibular canine

Maxillary First Molars (Fig. 2.8)

- The primary maxillary first molars usually erupt by 16 months of age.
- The primary maxillary first molar resembles a molar and a premolar.
- The occlusal surface consists of three cusps, one each on the mesiobuccal and distobuccal surfaces and one on the lingual surface. This gives the tooth a square look.
- There are three slender roots, one beneath each cusp tip.
- A characteristic of all primary molars is that the furcation of the roots begins at the cemento-enamel junction. This is not apparent in permanent molars. There is a very prominent buccal cervical ridge.
- *Anatomy of the pulp:* The pulp horns correspond to each cusp; the mesiobuccal pulp horn is the most prominent. The mesiobuccal pulp horn is 1.8 mm, the distobuccal pulp horn is 2.3 mm, and the palatal pulp horn is 2.0 mm from the cusp tip.

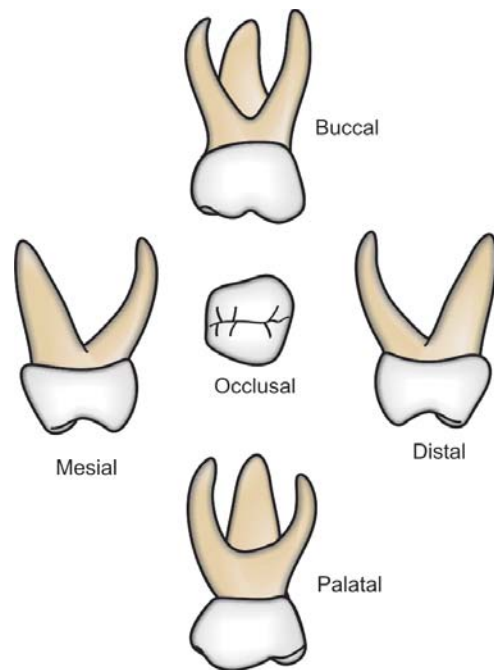


Fig. 2.8: Maxillary first molar

Mandibular First Molars (Fig. 2.9)

- This primary molar erupts by the 14-16th month of life.
- It has four cusps, two buccal and two lingual.
- The occlusal surface is narrow due to the convergence of the mesiobuccal and mesiolingual cusps.
- Transverse ridge is very prominent and divides the occlusal surface.
- The enamel of this tooth is uniformly thick.
- There are two broad but thin mesiodistal roots, one on the mesial aspect and one on the distal aspect.
- *Anatomy of the pulp:* There are four pulp horns with one pulp horn beneath each cusp. Both buccal and lingual mesial pulp horns are 2.1 mm from the DEJ while the distal pulp horns are 2.4 mm away from the DEJ.

Maxillary Second Molars (Fig. 2.10)

- The primary second molars are the last primary teeth to erupt, completing the primary dentition by 28-30 months of age.
- The primary maxillary second molar resembles the permanent maxillary first molar in appearance but is smaller.

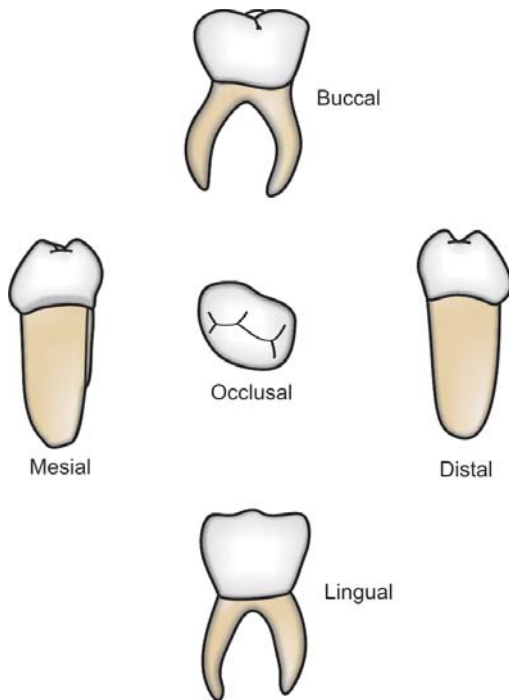


Fig. 2.9: Mandibular first molar

- The tooth is rhomboidal.
- There are four cusps, two on the buccal and two on the lingual aspects.
- Often there is a fifth cusp or prominence, called as the tubercle of Carabelli on the palatal surface of the mesiopalatal cusp.
- A prominent transverse or oblique ridge connects the distolingual cusp with the mesiopalatal cusp.
- There are three roots that are curved to accommodate the developing tooth bud beneath.
- The enamel is usually 1.2 mm thick uniformly on the tooth.
- *Anatomy of the pulp:* There may be four or five pulp horns, which usually are most prominent beneath each cusp tip. The mesiobuccal pulp horn, as usual, is the largest and closest to the DEJ. The mesiobuccal pulp horn is usually 2.8 mm from the DEJ, while the distobuccal horn is 3.1 mm from the DEJ.

Mandibular Second Molars (Fig. 2.11)

- The primary mandibular second molar resembles a permanent mandibular first molar.
- There are five cusps, three on the buccal surface and two on the lingual.
- The enamel is uniformly 1.2 mm thick.

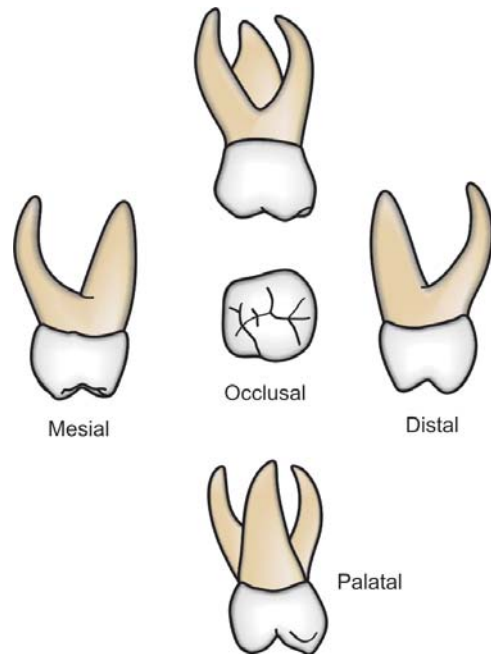


Fig. 2.10: Maxillary second molar

- There are two roots which are narrow mesiodistally but very broad buccolingually.
- The roots are somewhat curved to accommodate the developing tooth bud.
- *Anatomy of the pulp:* There are five pulp horns corresponding to the five cusp tips. The mesiobuccal pulp horn is the largest, extending 2.8 mm from the DEJ, while the distobuccal pulp horn is 3.1 mm from the dentinoenamel junction.

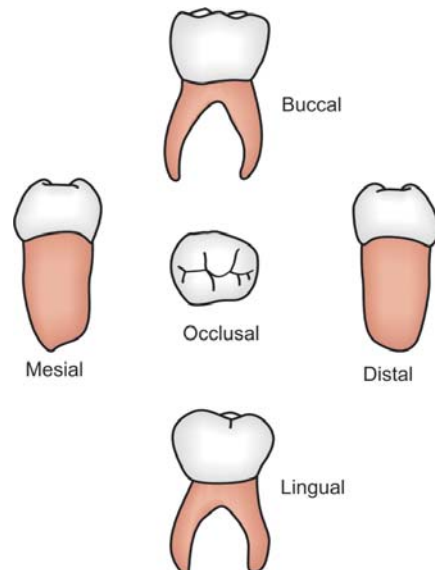


Fig. 2.11: Mandibular second molar



PRACTICAL APPLICATION OF UNDERSTANDING TOOTH MORPHOLOGY

Influence of primary tooth morphology for practical applications such as tooth preparations, stainless steel crown preparations, surgical procedures and pulp therapy are as follows:

Tooth Preparations

- A. Modifications in the cavity depth and extension is required due to reduced thickness of enamel and dentin.
- B. Width of the occlusal cavity should be very much narrow in compliance with the narrow occlusal table.
- C. The interproximal contacts of primary teeth are broad and flat compared to those of permanent teeth. Use of a good wedge at the cervical part of the proximal box is necessary during material insertion and condensation into the proximal box.
- D. It is difficult to obtain an adequate gingival seat while preparing a Class II cavity due to the cervical constriction present in deciduous teeth. Trying to prepare a gingival seat in a deep cavity may lead to encroachment into pulp chamber.

Stainless Steel Crown Preparations

- A. The prominent mesiobuccal cervical ridge of mandibular and maxillary first molars must be accommodated in the preparation of stainless steel crowns, which may otherwise result in a 'Rocking' crown.
- B. The gingival contour of the cervical margin that varies from the buccal to lingual to proximal aspects should be replicated while fabricating the crown. The cervical border of the crown must flow parallel to this gingival contour.
- C. The cervical border of the crown must be placed below the cervical bulge of the tooth to obtain maximum retention.

Surgical Procedures

- A. Conical roots of primary anterior teeth facilitate easy removal.

- B. Extraction of deciduous molar teeth must be made with great caution. The premolar tooth bud is located between the flared roots of primary molars, which may be avulsed during deciduous tooth extraction.

Pulp Therapy

- A. Understanding of the anatomy of the pulp, the number and curvature of the root canals is important during pulp treatment procedures.

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Chapter 3



Case History, Examination, Treatment Planning

1. Introduction
2. Patient Evaluation
3. Vital Statistics
4. Chief Complaint
5. History
 - History of chief complaint
 - Medical history
 - Past dental history
 - Family history
 - Personal history
6. Examination
 - General examination
 - Local examination
7. Provisional Diagnosis
8. Investigation
9. Final Diagnosis
10. Treatment Planning



INTRODUCTION

A thorough history, detailed examination and an accurate diagnosis, all of them are very essential for successful outcome of any treatment.

Diagnosis and treatment planning thus includes assembling all the relevant facts obtained through history and examinations and to analyze each of them for determining the course of treatment.

PATIENT EVALUATION

Patient evaluation helps:

1. To understand the difference between normal and abnormal.
2. In planning the treatment in an sequential order.
3. To determine the length of appointment.
4. To recognize any behavioral problems that may require treatment to be done under general anesthesia in a hospital setting.
5. To identify any medical problems that may require intervention or any modification in treatment.

Obtaining accurate data in a child is very difficult. The reasons may be due to any of the reasons given below:

1. Most of the times it is the parent or the guardian who will be providing the required data about the child and not the child himself or herself.
2. It is impossible to observe everything a child does or says and make accurate records of what goes on.
3. Most children do not behave in the dental clinic, the same way as they do at home or with their friends or teachers.
4. Data reported by parents and teachers may be inaccurate.
5. Information provided by parents or guardians is dependable on their emotional maturity.
6. Unless reports are made immediately after the observation, the parents may forget to mention minor yet important findings.
7. There may be a deliberate distortion by the observer to show the child or the parent in a favorable light.

The sequence of steps from case recording to implementation of the required plan are as follows:

1. Vital statistics
 - a. Hospital registration number with date of first visit
 - b. Name
 - c. Age
 - d. Sex
 - e. Class and school
 - f. Parents name and occupation
 - g. Address and telephone number.
2. Chief complaint
3. History
 - a. History of the chief complaint
 - b. Medical history – Prenatal, natal, postnatal and present history.
 - c. Past dental history
 - d. Family history
 - e. Personal history- Oral hygiene, diet and oral habit history.
4. Examination
 - General examination
 - *Local examination:* Extra-oral examination
 - a. Shape of the head
 - b. Shape of the face
 - c. Facial profile
 - d. Facial symmetry
 - e. Facial divergence
 - f. Facial height
 - g. Temporomandibular joint
 - h. Lymph nodes
 - i. Eyes
 - j. Nose
 - k. Forehead
 - l. Nasolabial angle
 - m. Lips
 - n. Mentolabial sulcus
 - o. Chin
 - *Local examination:* Intra-oral examination
 - a. Soft tissue examination
 - b. Saliva
 - c. Halitosis
 - d. Hard tissue examination-
 - Teeth present
 - Hard tissue status
 - Occlusion: Molar, canine and incisal relationship



- Curve of spee
- Mobility/depressibility of teeth
- e. Breathing pattern
- f. Swallowing pattern
- g. Physiologic spacing
- h. Midline.
- 5. Provisional diagnosis
- 6. Investigation
- 7. Final diagnosis
- 8. Treatment planning
 - a. Medical phase
 - b. Systemic phase
 - c. Preventive phase
 - d. Corrective phase
 - e. Maintenance and recall.

VITAL STATISTICS

Hospital Registration Number

It is recorded for the purpose of organized file keeping, billing and also legal purposes.

Date

Records patient's first visit which can be referred back to.

Name

Recording nick names are useful in pediatric practice. Children are at ease when they are referred to by the same names as they are referred at home.

Purpose of recording the patients name is for:

- Identification.
- To maintain records.
- Communication.
- To develop rapport with the patient.

Chronologic Age

It is the age of the child calculated from his/her birthday. Some of the reasons why recording age is important are:

- Behavior management techniques that have to be chosen are definitely age dependent.
- To relate the eruption and exfoliation sequence of teeth. It helps to compare the dental age of the patient

- with chronologic age and if needed to initiate any preventive or interceptive methods of treatment.
- To also compare the chronologic age with the skeletal and mental age.
- Understanding the period of growth spurts are important for treatment planning. Growth modifications by means of functional and orthodontic appliance elicit better response during the period of growth spurts.
- Certain diseases occur in certain age groups and it aids to diagnose a disease based on age factor.

Sex

- Certain diseases are specific to either of the sexes, such as hemophilia is common in males or juvenile periodontitis in females.
- Timing of eruption sequence also varies between males and female. Eruption is slightly earlier in females.
- Behavior management technique may vary depending on the sexes depending on the likes and dislikes of the child. Boys like toys such as cars and aeroplanes while girls like dolls. One can please a girl child by praising her dress or looks. A boy child would be praised with regards to his activities than dress.
- Variation in timing of growth spurts is seen between girls and boys.

Class and School

- Helpful to correlate the patient's chronological age with mental age.
- Gives some indication regarding the socioeconomic background of the child.

Parent's Name and Occupation

- For communication.
- Understanding the socioeconomic condition.

Address

- Communication
- Some areas are endemic to certain diseases or conditions. Example if the patient is residing in the



area with high water fluoride content, there is increased chance that he might be having dental or skeletal fluorosis.

CHIEF COMPLAINT

It is the reason which prompted the patient to seek dental treatment.

- Common reasons for seeking treatment includes pain, swelling and to improve esthetics or may be referred from other practitioner.
- While recording the chief complaint it must be made in the chronological order, that is what appeared first should be mentioned first.
For example, if the patient complains of fever from yesterday, pain since four days and swelling began two days back. It should be recorded as follows:
 - Pain of 4 days duration
 - Swelling of 2 days duration
 - Fever of 1 day duration.

HISTORY

History of Chief Complaint

It includes extracting more information regarding the chief complaint that will be helpful in treatment planning.

For example if the complaint is pain, the history to be obtained includes:

- *Location of pain:* It is required to identify the offending tooth or teeth.
- *Inception – ‘when did it start’:* Pain that started few hours to days indicates that it is an acute condition, and similarly pain that is present for many days or months is most of the time related to a chronic condition.
- *Provoking factors or aggravating factors:* There may be some factors that initiates or increases the pain. For example the pain that increases while lying down, is usually due to pulpal hyperemia or pain present only while eating may be due to deep caries (pressure through thin dentin to pulp) or reversible pulpitis. Spontaneous pain without any provoking factors indicates wide involvement of pulp and requires radical therapy such as pulpectomy.

- *Attenuating factors or relieving factors:* Understanding factors that reduce or stops the pain is also important. Pain that is relieved by removal of the stimuli indicates reversible pulpitis.
- *Duration:* Pain if present following a stimulus, for a short period or is transient in nature, indicates reversible pulpitis. Pain that begins on provocation and lingers on even after removal of stimulus indicates a irreversible pulpitis.
- *Intensity and quality:* sharp, lacinating pain indicates acute condition and chronic condition is associated with dull, gnawing type of pain.
- *Radiation:* Pain can be radiated to other teeth or tissues. This makes it difficult to identify the diseased tooth or teeth. A tooth associated with chronic pain is most of the time radiated to the tooth in the opposite arch or the patient just cannot pinpoint the involved tooth. Pain due to only pulpal origin is also difficult to point.

Type of pain—can be sharp, dull, continuous, intermittent, mild, severe, etc.

Pain in the pulp only—is difficult to localize, as the pulp does not contain proprioceptive fibers unlike the pain of the periodontium.

Pain increased by lying down—is due to increase in blood pressure to the head, which increases the pressure on the confined pulp.

Medical History

- Treatment must be postponed if the patient is suffering from acute illness such as mumps, chicken-pox, etc.
- History of rhinitis, repeated cold, adenoidectomy, tonsillectomy should be carefully examined for evidence of persisting nasal obstruction before undertaking orthodontic treatment with appliance such as oral screen, activator, etc.
- Patients with cardiac defects should be referred to a pediatrician. Antibiotic prophylaxis must be given prior to any treatment to minimize the risk of development of subacute bacterial endocarditis (SABE).



- During anticoagulant therapy, adjustment of anticoagulant dosage may be required.
- Communicable disease –precaution to avoid contacting the disease.
- Drug allergy or interactions.
- History of psychological problems, if any must be obtained. This will help us during management of the child's behavior during the procedure.

Medical history can be obtained under four headings:

1. Prenatal history
2. Natal history
3. Postnatal history
4. Recent medical history

Prenatal History

It includes history of the mother during her pregnancy period and includes about:

- Nutritional disorders
- *Drugs history*: Teratogens may cause abnormal development of the fetus and some drugs like tetracycline may cause discoloration of the teeth.
- *Diseases*: Viral infections are said to cause cleft lip or palate. German measles during first trimester may result in cleft lip and cleft palate.
- *Accidents/trauma*: Trauma may result in orofacial deformity, due to damage to the growth centers.
- Abnormal fetal position may result in abnormal pressure on some part of the face leading to facial asymmetry.

Natal History

It includes history of child at the time of birth:

- Injury to the temporomandibular joint at the time of birth such as may occur during forceps delivery can affect growth of the condyle and in turn the mandible.
- Cyanosis at birth may indicate congenital cardiac disease.
- Rh incompatibility that may lead to erythroblastosis fetalis.

Postnatal History

It includes history of the early infant period of the child:

- Includes history relating to the type and duration of feeding habits, nutritional disturbances.
- Trauma, childhood diseases.

- Developmental milestones.
- History of immunization.

Vaccination Schedule-Recommended by the Indian Academy of Pediatrics (1999)

Age	Vaccine
Birth	BCG Oral polio vaccine – 1st dose Hepatitis B vaccine -1st dose
6 weeks	DPT – 1st dose Oral polio vaccine – 2nd dose Hepatitis B vaccine – 2nd dose
10 weeks	DPT - 2nd dose Oral polio vaccine - 3rd dose
14 weeks	DPT - 3rd dose Oral polio vaccine – 4th dose
6-9 weeks	Oral polio vaccine – 5th dose Hepatitis B vaccine – 3rd dose
9 months	Measles vaccine
15-18 months	MMR(Measles, Mumps, Rubella) DPT- 1st booster dose Oral polio vaccine – 6th dose
5 years	DPT– 2nd booster dose Oral polio vaccine – 7th dose
10 years	TT (tetanus) - 3rd booster dose Hepatitis B vaccine - booster dose
15 -16 years	TT (tetanus) – 4th booster dose
Optional vaccines	Typhoid fever vaccine <i>Haemophilus influenzae</i> type – B vaccine Hepatitis A vaccine Varicella (chickenpox) vaccine

Recent Medical History

It helps to alter or modify the treatment plan in accordance to the child's systemic condition. Please refer chapter on Medically Compromised Children for further details. The history briefly includes:

- History of recent hospitalization or medication.
- *Drug or any other allergy*: Children normally tend to be more allergic to drugs, food items, etc than adults and it suppresses as they grow.

When there is indication of an acute or chronic systemic disease or anomaly, dentist should consult the child's physician to learn the status of the condition, long range prognosis and the current drug therapy.

Dentist should be alert to identify potential communicable infections conditions that threaten the health of the patient and others as well. Then it is advisable to postpone non-emergency dental care.



Past Dental History

- Gives the attitude of the patient towards dentistry
- History of previous bad experience needs careful handling.

Family History

- Provides some indication of the hereditarily influenced development of the patient.
- Attitude of the parents towards the oral hygiene, health and dentistry has to be assessed as it may be reflected in the behavior of children.
- Infectious diseases in the family such as tuberculosis should be carefully dealt with.

Personal History

Oral Habits History

- It includes recording the frequency, intensity, duration of the habits such as finger/thumb sucking, nail biting/lip biting, tongue thrusting, bruxism, mouth breathing etc. Refer chapter on Pernicious Oral Habits for details regarding examination for pernicious oral habits.

Oral Hygiene History

It includes history related to the maintenance of oral hygiene:

- Number of times and method of brushing.
- History regarding 'who' brushes the teeth is very important especially in children less than 5 years. Refer chapter no. 14 for brushing techniques for children.
- Use of fluoridated or non-fluoridated dentrifices
- *Brush:* Type of brush and how often it is changed.
- Other oral hygiene aids used like flossing, rinses, etc.

For normal brushing techniques and preventive procedures refer chapter no 14.

Diet History

- Twenty four hour recall history is routinely used. Ideal method would be to record a full week diet history including a weekend. Refer chapter No. 14 for detailed diet history discussion.

EXAMINATION

General Examination

General Well-being of the Child

A brief survey of the entire body is made.

Height and Weight (Figs 3.1 and 3.2)

It is possible to determine whether an individual's growth is progressing normally or abnormally by comparing his/hers height and weight with the standard height and weight chart (Fig. 3.3).



Fig. 3.1: Height can be measured using colorful measuring scale



Fig. 3.2: Calibrated weighing machine should be used for measuring the weight of the child

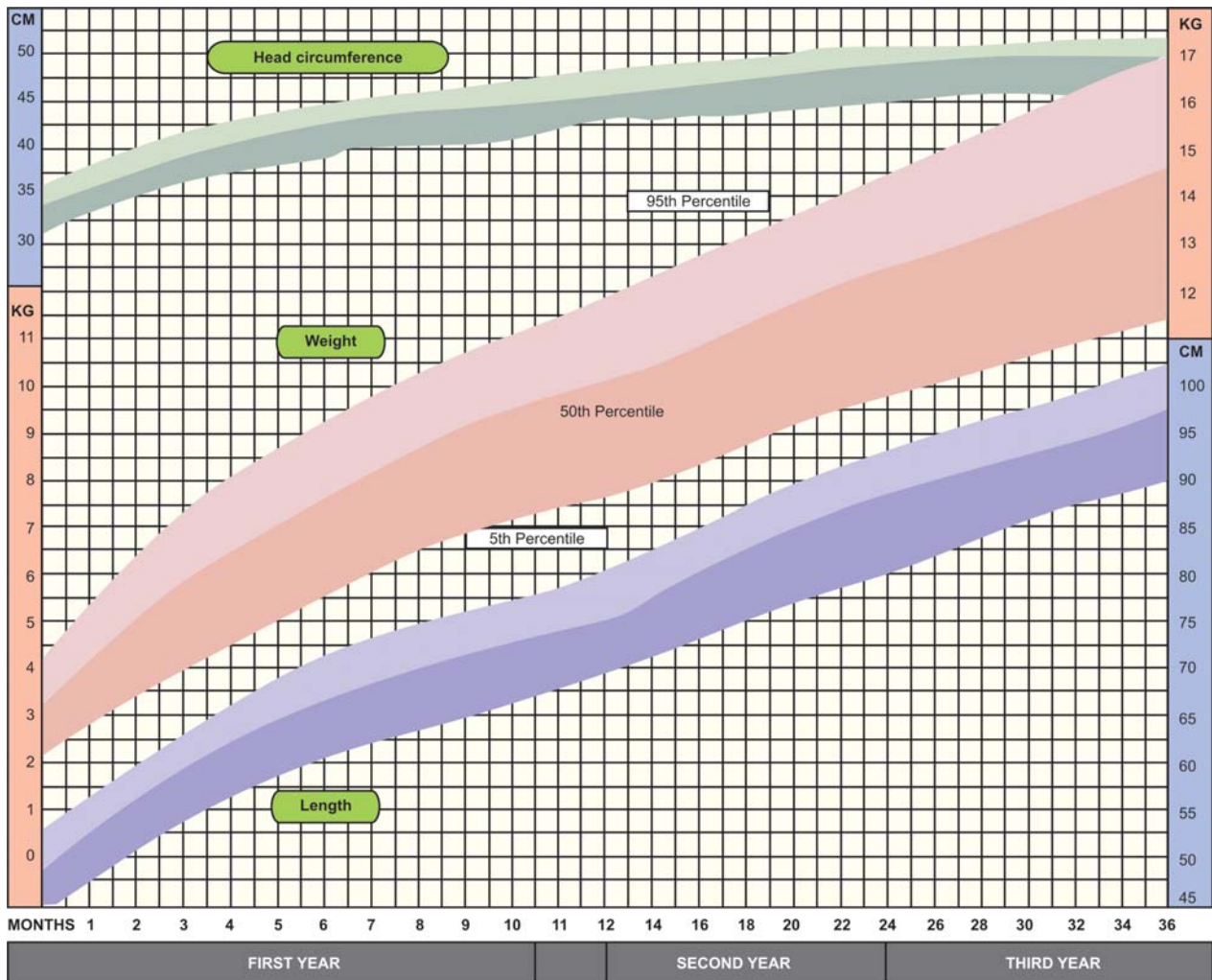


Fig. 3.3: Standard height and weight chart for children upto 3 years

Built

William Sheldon in 1940's categorized human bodies into 3 categories:

1. *Ectomorph*: Late maturer, tall, thin and fragile long and slender extremities with minimum subcutaneous fat and muscle. They have flat chest, lightly muscled body.
2. *Mesomorph*: Upright, sturdy, athletic. Muscle, bone and connective tissue predominate. They have a hard muscular body.
3. *Endomorph*: Early maturer, round shaped, usually stocky with abundant subcutaneous fat, highly developed digestive viscera, underdeveloped muscles with soft body.

Gait

Most common abnormal gait is weak, unsteady gait of lethargy and malaise in ill patients. Other types of gait are – waddling, equines, staggering, hemiplegic, scissors, ataxiac, stepped, shuffling or wobbly.

Speech

Speech disorders can be:

- a. *Aphasia* (loss of speech secondary to central nervous system damage).
- b. *Delayed speech* (due to hearing loss, intellectual retardation, developmental retardation, poor environmental stimulation).



Fig. 3.4: Frankfort horizontal plane

- c. *Stuttering or repetitive speech* (where the child repeats some or most of the words and is due to psychological stress).
- d. *Cluttering* is an unusual type of speech characterized by repetition of words or phrases, false starts, changes in context in the middle of the sentence and general verbal confusion.

Local Examination

Patients Frankfort Horizontal (FH) plane should be parallel to the floor during examination (Fig. 3.4).

Extra-oral Examination

Shape of the Head (Fig. 3.5)

$$\text{Cephalic index (CI)} = \frac{\text{Maximum skull width (Transverse dimension)}}{\text{Maximum skull length (Anteroposterior dimension)}}$$

Based on the classification by Martin and Saller (1957), shape of the head can be classified as (Figs 3.6A to C):

- **Mesocephalic** – average, cephalic index (CI) is 76.0 - 80.9.
- **Dolichocephalic** – long and narrow, CI is < 75.9
- **Brachycephalic** – broad and short, CI is 81.0 - 85.4
- **Hyperbrachycephalic** – CI is > 85.5

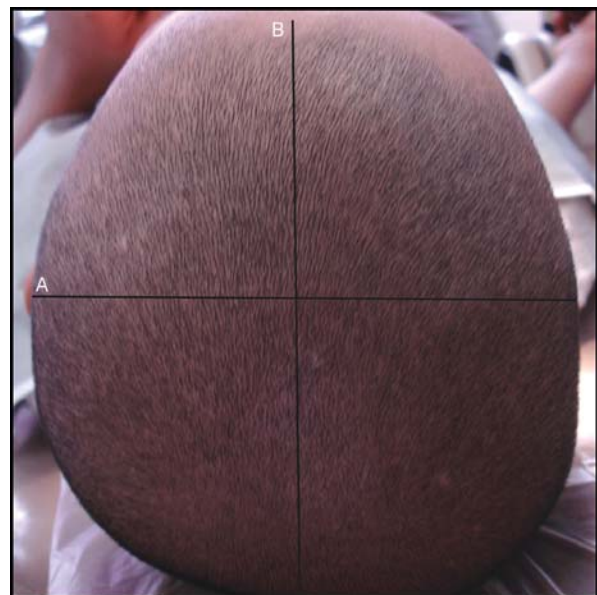


Fig. 3.5: Measuring the shape of the head: (A) Transverse dimension; (B) Anteroposterior dimension

Shape of the Face (Fig. 3.7)

Morphologic facial index,

$$\text{MFI} = \frac{\text{Morphologic facial height (point N to Gn)}}{\text{Bizygomatic width (ZY to ZY)}}$$

Based on the classification by Martin and Saller (1957), shape of the face can be classified as (Figs. 3.8A to C)

- **Dolichoprosopic or leptoprosopic** – high facial skeleton, long and narrow – oval, MFI is 88.0-92.9.
- **Euryprosopic** – low facial skeleton, broad and short – round, MFI is 79.0-83.9.
- **Mesoprosopic** – average – square, MFI is 84.0-87.9.

Facial Profile (Fig. 3.9)

Nasion, point A and the pogonion are considered. Facial profile can be (Figs 3.10A to C):

- **Straight** – When all the 3 points are in the same vertical plane, seen in class I malocclusion.
- **Convex** – if point A is ahead or pogonion is behind, seen in class II division 1 malocclusion.
- **Concave** – if point A is behind or pogonion is front, seen in class III malocclusion.



A



B



C

Figs 3.6A to C: Different shapes of head. A. Dolichocephaly; B. Mesocephaly; C. Brachycephaly

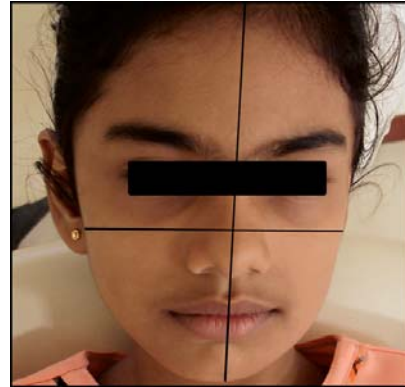


Fig. 3.7: Recording the shape of the face



A



B



C

Figs 3.8A to C: Different shapes of the face: (A) Dolichoprosopic or leptoprosopic, (B) Euryprosopic and (C) Mesoprosopic

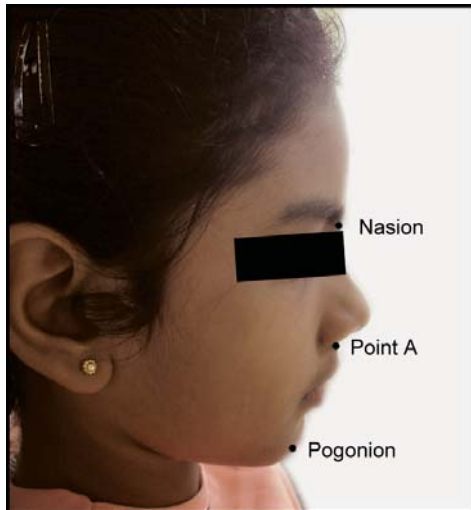


Fig. 3.9: Landmarks used for recording the profile of the face

Facial Symmetry

It is better visualized from above the head, the operator standing behind the patient as shown in Figure 3.11.

Gross asymmetry of face can be due to–

- Abscess due dental infections
- Parotid enlargement
- Hemifacial hypertrophy/atrophy
- First arch syndrome
- Unilateral condylar hyperplasia
- Unilateral ankylosis of TMJ.



Fig. 3.11: It is easy to differentiate the change in facial symmetry when visualized from this view

Facial Divergence (Fig. 3.12)

Facial angle (FA) is used, which is formed by NA-Pog soft tissue line and FH line.

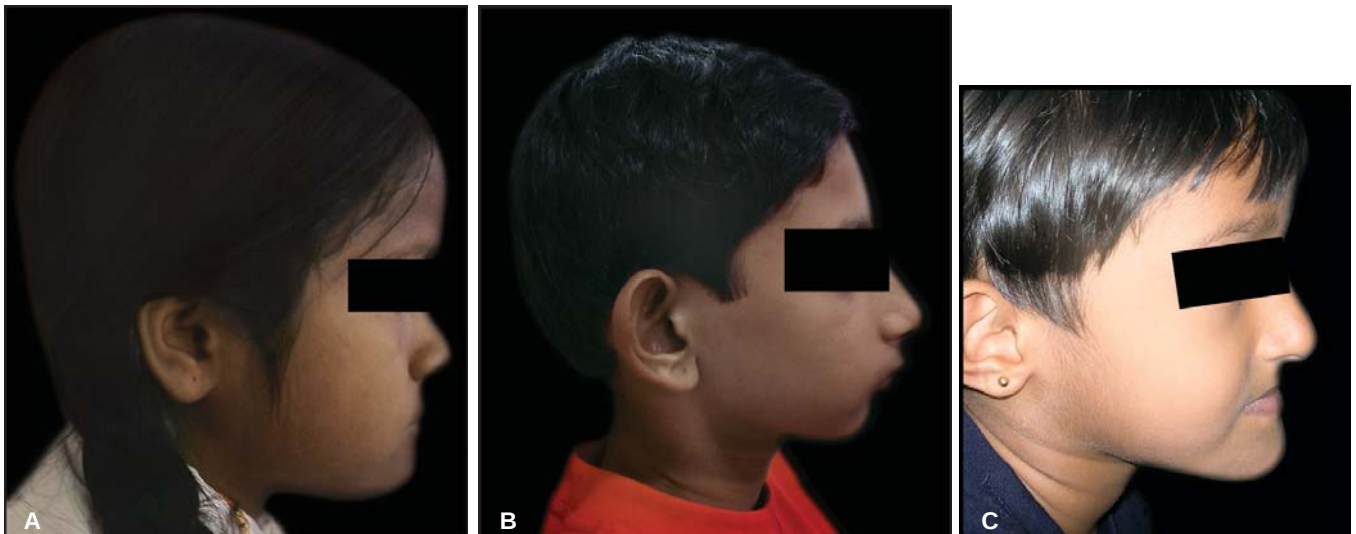
It can be of three types:

- *Orthognathic* – FA is approximately 90°
- *Posteriorly divergent* – low FA
- *Anteriorly divergent* – high FA

Facial Height (Fig. 3.13)

Upper facial height:

- From the bridge of the nose to the lower border of the nose or NA to ANS – 45% of the total facial height.



Figs 3.10A to C: (A) Straight, (B) Convex and (C) Concave profile of the face

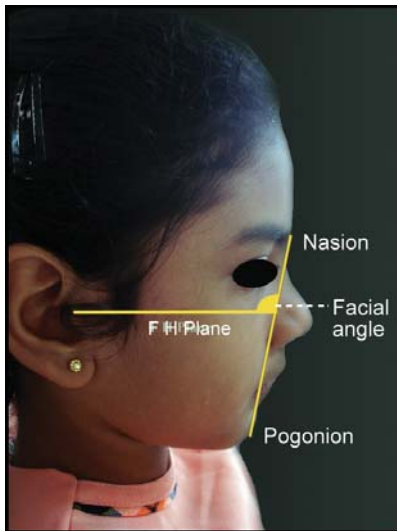


Fig. 3.12: Facial angle formed by NA-Pog soft tissue line and FH line

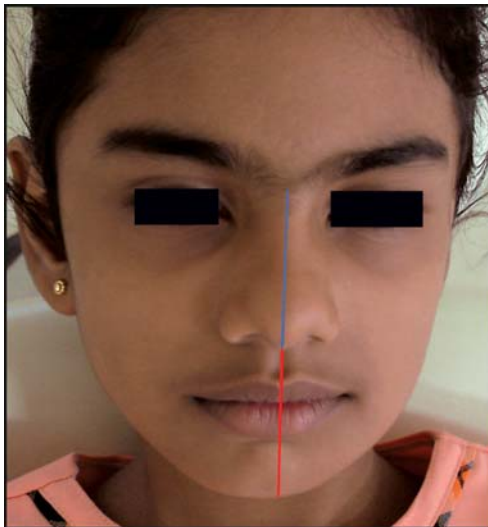


Fig. 3.13: Facial height. A. Upper facial height (Blue line); B. Lower facial height (Red line)

Lower facial height:

- From the lower border of the nose to the lower border of the chin (ANS to Me) – 55% of the total facial height.

Lower facial height

Increased	Lowered
1. Skeletal open bite	1. Growing children
2. Long face syndrome	2. Skeletal deep bite
	3. Class II division 2



Fig. 3.14: Operator should stand in front of the patient to observe the path of closure of mandible



Fig. 3.15: Index finger is placed in front of the tragus to palpate the anterior border of the condyle

Temporomandibular Joint

Temporomandibular joint is palpated by standing in front of the patient. This helps to visualize the movement of the mandible during the opening and closure of the jaw and thus note any discrepancies. The head of each mandibular condyle can be palpated by placing the index finger in front of the tragus and the posterior border of the condyle can be palpated by placing the index finger in the external acoustic meatus.

Examination of TMJ (Figs 3.14 to 3.16)

- It reveals pain on pressure and synchrony of action of left and right condyle.



Fig. 3.16: Index finger is placed in the external acoustic meatus to palpate the posterior border of the condyle

- Discrepancies of TMJ such as muscular imbalances, anatomic deviations, swellings or redness over joint region, trismus and spasm of muscles can be noted.
- Palpation of muscles of mastication is also very important. Lateral pterygoid and masseteric pain is also encountered associated with TMJ problems.

Path of closure: Altered in:

- Occlusal prematurities
- Lingually or palatally erupting incisor
- Class II division 1- habitual forward positioning
- Class III – forward displacement.
- Backward path of closure or posterior displacement.
- Lateral path of closure in unilateral cross bite cases.

Clicking may be initial, intermediate, terminal and reciprocal.

- Initial clicking – sign of retruded condyle in relation to disk.
- Intermediate clicking – unevenness of the condylar surfaces and of the articular disk which slides over one another during the movements.
- Terminal clicking – most common and is due to the condyle being moved too far anteriorly in relation to the disk on maximum jaw opening.
- Reciprocal clicking – occurs during opening and closing and expresses an incoordination between displacement of the condyle and disk. Clicking of the joint is rare in children.



A



B

Figs 3.17A and B: Examination of the lymph nodes; (A) Submandibular lymph nodes; (B) Submental lymph nodes

Lymph Nodes (Figs 3.17A and B)

Submandibular and submental lymph nodes are the ones commonly involved during dental infections. Other nodes in the head and neck area should be checked as routine procedure.

Eyes

Inflammation associated with maxillary teeth may extend to the orbital region causing swelling of the eyelids and conjunctivitis. Eyes also serve as indicators for anemia, jaundice, etc.

Nose

- Contour (nasal bridge) can be – straight, convex, crooked.



- Size – height should be about 1/3rd of total facial height. Microrhinc is associated with high root of the nose, short nasal bridge and an elevated tip. Large nasal profile is associated with deep root of the nose, long nasal bridge and a protruding lip.
- Ratio between the horizontal length with the height of the nose is 2:1.
- Nostrils – width is approximately 70% of the length of the nose.
- Certain infectious diseases leave their marks on nose. For example: Saddle nose in congenital syphilis
- Identifying deviated nasal septum is important in mouth breathers.

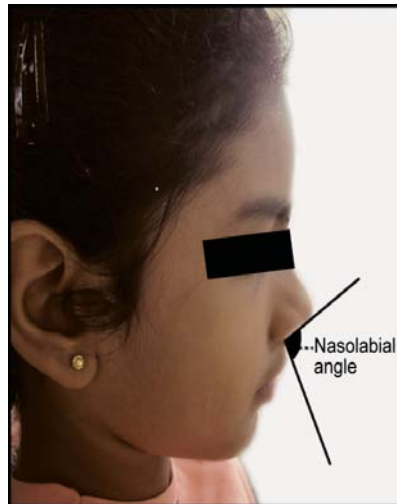


Fig. 3.18: Nasolabial angle

Forehead

- Profile of face is influenced by the shape of the forehead and nose.
- Harmonious facial morphology = height of the forehead should be 1/3 of the entire face height that is it must be as long as the middle and lower third.
- Height of the forehead (Upper 1/3 of the face) = distance of hairline to the glabella (middle 1/3 is from glabella to subnasal and lower 1/3 from subnasal to menton).
- Contour can be flat, protruding or oblique. Steep forehead is usually associated with prognathic dental bases than with flat forehead.



Fig. 3.19: Normal competent lips

Nasolabial Angle (Fig. 3.18)

- It is the angle formed between lower border of nose to the upper lip and is 90-110°
- Decreased in cases of proclined maxilla, tense upper lip, prognathic upper teeth.
- Increased in retrusive maxilla, retruded upper teeth.

Lips

- Normally competent– touch each other lightly or with 0-1 mm of gap (Fig. 3.19). When the lips do not approximate each other at rest they are termed as incompetent (Fig. 3.20).
- Length – upper lip covers the entire labial surface of upper anterior teeth except the incisal third or incisal 2-3 mm.



Fig. 3.20: Incompetent lips



A



B



C

Figs 3.21A to C: Lip profile. (A) Positive lip step; (B) Normal lip step; (C) Negative lip step

- Tonicity and color – Normal is pink and firm, hypoactive lip is lighter in color and is flaccid.
- Hypotonic lip is flaccid.
- Lip protrusion is influenced by the thickness of the soft tissue, tone of the muscles, position of the anterior teeth and configuration of underlying bony structures.
- Lip step (profile) according to Korkhaus are of three types (Figs 3.21A to C).
 - i. Positive lip step – protruded lower lip associated with class III relation.
 - ii. Normal lip relation has a mild negative lip, with upper lip mildly protruded compared to the lower lip.
 - iii. Marked negative lip step – protruded upper lip, class II relation.
- Ulcers, vesicles, fissures, crusts and abrasions are frequently seen on lips and should be noted. Nutritional and allergic reactions may also cause changes in lips.

Mentolabial Sulcus (Fig. 3.22)

- It is the region between the lower lip and the mentalis muscle.
- Normal – Seen in class I occlusion.
- Deep – class II div 1.
- Shallow – Seen in bimaxillary protrusion.

Chin (Fig. 3.23)

- Chin prominence is related to mandibular position. Recessive chin is associated with mandibular retrognathism or class II molar relation. Prominent or prognathic chin is associated with mandibular prognathism or class III molar relation. Normally



Fig. 3.22: Mentolabial sulcus



Fig. 3.23: Chin examination

positioned chin is associated with straight profile or class I molar relation.

Normal – seen in class I occlusion.

- Increased height of the chin alters the position of the lower lip and interferes with the lip closure.

Intra-oral – Soft Tissue Examination

Soft tissue should be examined for 3C's, change in the color, contour and consistency.

Change in Color

It may be a change to red (inflammation), blue (hematoma, bruise) or white (electric or thermal burns, candida infection).

Change in Contour

It may be due to either a swelling (abscess, papilloma) or ulcer (apthous, traumatic).

Change in Consistency

It may be soft (inflammation), firm (mucocele) or hard (bony exostosis).

Gingiva (Figs 3.24 and 3.25)

- High maxillary labial frenal attachment may be responsible for abnormal spacing between the central incisors (Fig. 3.26).

- Redness and swelling of gingival may be seen associated with gingivitis (Fig. 3.27).
- Draining fistula on the attached gingiva accompanied by a tooth that is tender, painful and mobile are usually diagnostic of abscessed teeth.



Fig. 3.24: Normal healthy gingiva



Fig. 3.25: Normal healthy gingiva with melanin pigmentation



Fig. 3.26: High frenum attachment causing midline diastema

Tongue

- The size, shape, color and movement of the tongue should be noted.

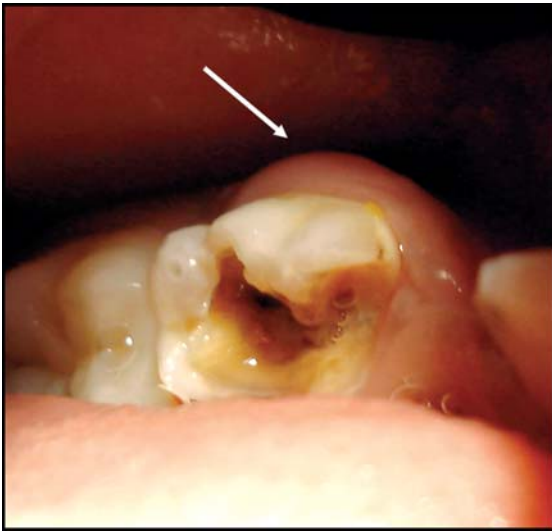


Fig. 3.27: Swelling associated with a non-vital tooth changing the contour of the gingiva



Fig. 3.28: Tongue tie or ankyloglossia

- Dryness of tongue – indicates dehydration.
- Tongue is coated in febrile state.
- Abnormal lingual frenum can result in 'tongue tie' or ankyloglossia (Fig. 3.28).

Saliva

- May be thin, normal or viscous.
- Altered secretions are seen in systemic conditions such as mumps, Shögren's syndrome, etc.

Halitosis

- May be due to poor oral hygiene, blood in mouth, dehydration, sinusitis, infection of adenoid tissue, disturbances of alimentary tract, etc.

Intra-oral – Hard Tissue Examination

Basic instruments used for examination includes a mouth mirror, explorer, straight probe, tweezer and a spoon excavator (Fig. 3.29).



Fig. 3.29: Instruments that are required for examination

Teeth Present (Fig. 3.30)

There are different systems used for tooth numbering, of which the one recommended by the FDI is preferred.

The teeth are numbered as follows:

Deciduous teeth,

55,54,53,52,51,61,62,63,64,65

85,84,83,82,81,71,72,73,74,75

Permanent teeth,

18,17,16,15,14,13,12,11,21,22,23,24,25,26,27,28

38,37,36,35,34,33,32,31,41,42,43,44,45,46,47,48

The first number denotes the quadrant and second denotes the tooth.



Fig. 3.30: Teeth denoted by FDI system of tooth numbering

Hard Tissue Status

Decayed teeth (Fig. 3.31): The teeth should be cleaned thoroughly before attempting to check for decay. Refer chapter 12 for diagnosis of caries.



Fig. 3.31: Decayed teeth



Fig. 3.32: Discolored non-vital tooth



Fig. 3.33: Discoloration due to enamel hypoplasia

Discoloration (Figs 3.32 and 3.33): Difference should be made regarding discoloration which may be due to extrinsic or an intrinsic reason. Food stains or tobacco stains cause discoloration on the surface of the tooth. The cause for discoloration in a non vital tooth is due to intrinsic reasons. Other reasons that causes intrinsic change in the color are enamel hypoplasia, fluorosis, etc.

Other abnormal findings (Figs 3.34 and 3.35): Such as rotated teeth, mobile tooth, root stumps, etc should be noted.

Occlusion

Molar relationship

- i. **Permanent teeth**—Classified based on Angle's class I, II and III (Figs 3.36A to C)

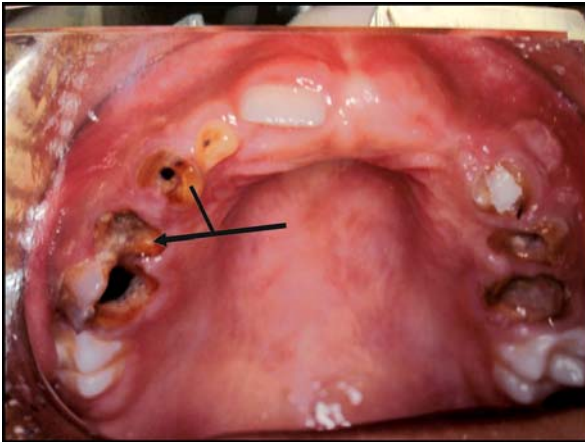


Fig. 3.34: Root stumps

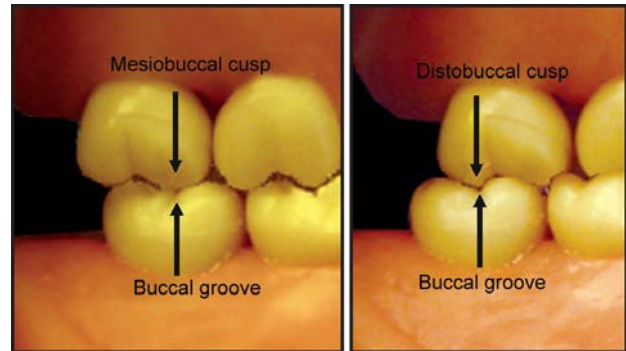


Fig. 3.35: Malocclusion

- **Class I molar relation:** Mesiobuccal cusp of the upper first permanent molar occludes with the mesiobuccal groove of the lower first permanent molar.
- **Class II molar relation:** Distobuccal cusp of the upper first permanent molar occludes with the mesiobuccal groove of the lower first permanent molar.
- **Class III molar relation:** Mesiobuccal cusp of the upper first permanent molar occludes in between the lower first and second permanent molar.

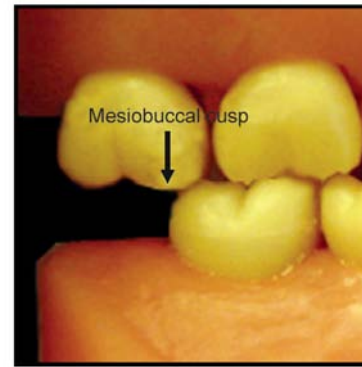
ii. Deciduous teeth—Based on Baume's terminal plane relationship into flush terminal plane, Mesial step terminal plane and distal step terminal plane (Figs 3.37 A to C).

- *Flush terminal plane relation:* Distal surface of the upper second deciduous molar is in



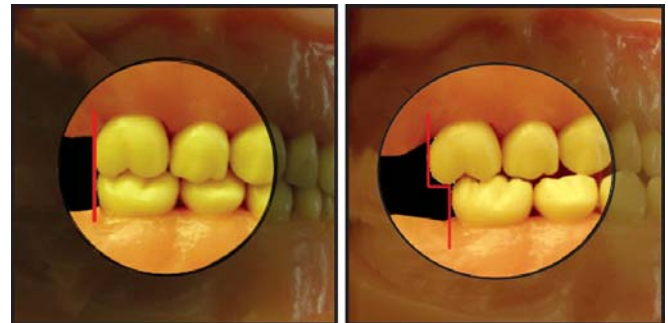
A

B



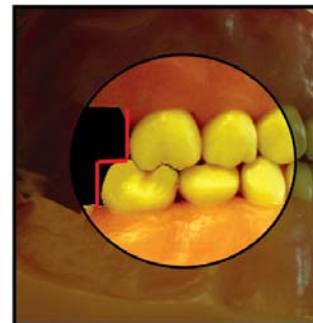
C

Figs 3.36A to C: Angle's permanent molar relation: (A) Class I; (B) Class II; (C) Class III



A

B



C

Figs 3.37A to C: Deciduous molar relation. (A) Flush terminal plane relation; (B) Mesial step relation; (C) Distal step relation



line with the distal surface of the lower second deciduous molar.

- **Mesial step relation:** Distal surface of the lower second deciduous molar is mesial to the distal surface of the upper second deciduous molar.
- **Distal step relation:** Distal surface of the lower second deciduous molar is distal to the distal surface of the upper second deciduous molar.

Please refer the chapter 6 for the importance of these relations in relation to the permanent molar occlusion.

Canine relationship: It can be class I, II or III (Fig. 3.38)

- **Class I relation:** Distal slope of the lower canine occludes with the mesial slope of the upper canine
- **Class II relation:** Mesial slope of the lower canine occludes with the mesial slope of the upper canine
- **Class III relation:** Lower canine is placed more mesially than class I relation almost extending between the lateral and central incisor.

Incisal relationship (Figs 3.39A to C): The upper and lower incisors can be related in both horizontal and vertical planes.

i. Over jet:

- Horizontal overlapping of upper and lower teeth.
- It is measured from labial surface of lower anterior to incisal edges of upper anterior teeth, when in centric occlusion.
- Normal is 2-3 mm.

ii. Overbite:

- Vertical overlapping of the incisors.
- It is measured from the incisal edge of the lower incisors to the point of extension of the upper incisor on the labial surface of the lower incisors when in centric occlusion.
- Normal is 2-3 mm.
- Deep bite is when over bite >2-3 mm.
- When lower incisors contact the palatal mucosa it is termed as complete deep bite.
- Closed bite is observed in class II division 2 where the upper anterior teeth overlaps lower anterior completely.
- Open bite is described when there is no contact between the upper and the lower anterior teeth.

- True deep overbite is due to infraocclusion of molars with large freeway space.
- Pseudo deep overbite is due to overeruption of incisors with small freeway space.

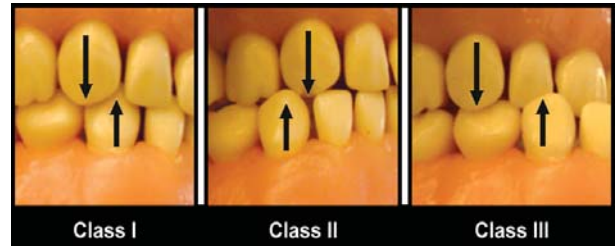
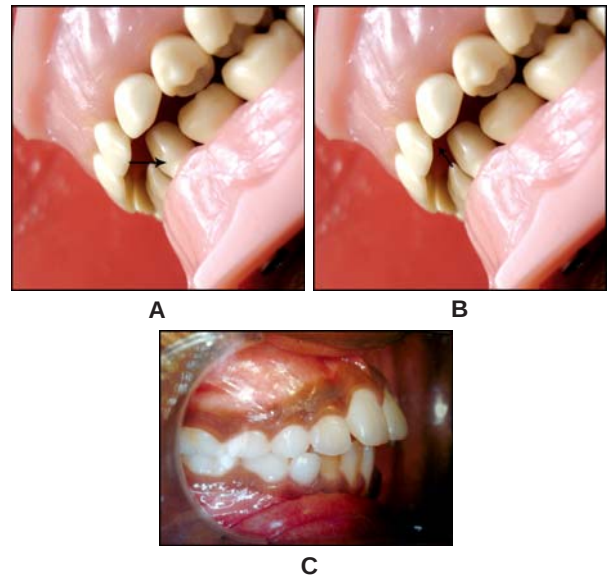


Fig. 3.38: Canine relations



Figs 3.39A to C: Incisal relation. (A) Over Bite; (B) Over jet; (C) Increased over jet

iii. Curve of spee:

- Deciduous teeth normally presents with a steep curve of spee.
- A steep curve of spee restricts the amount of space available for the upper teeth and is often combined with crowding
- A flat curve allows a good occlusion.
- A reverse curve of spee creates excessive space in the upper jaw.

iv. Breathing pattern:

- Can be nasal, oral or combination
- Methods to diagnose abnormal breathing is given in chapter titled pernicious oral habits.



v. Swallowing pattern

Normal patterns are:

- **Normal infantile pattern** – Seen before the eruption of the buccal teeth in the primary dentition. Mandible is stabilized by contraction of facial muscles.
- **Normal mature pattern** – Attained by 18 months of age. The maxillary and mandibular teeth are in contact. The mandible is stabilized by trigeminal or V cranial nerve. Tip of the tongue is held against the anterior portion of the hardpalate above and behind the incisors with minimal contraction of the lip. The middle portion of the tongue touches the middle of the hardpalate and the posterior portion forms 45° with the posterior pharyngeal wall.
- **Abnormal patterns:** It is discussed in chapter 10.

- vi. Physiologic spacing (Fig. 3.40):** It can be present or absent. Its absence gives some idea regarding the probability of future malocclusion.



Fig. 3.40: Normal spacing present in deciduous dentition

- vii. Dental midline:** The midline of the dentition coincides with the interincisal line between the upper and the lower central incisors. The upper interincisor line also coincides with the center of the philtrum or the midpalatine raphe. The patient is asked to occlude in centric occlusion. An imaginary line is drawn extending from between the upper central incisors and passing down between the lower central incisors. This line should be in straight line and coincide with philtrum or

mid palatine raphe. Any deviation (Fig. 3.41) must be noted and the etiology assessed.

Midline shift usually occurs due to supernumerary tooth (where the midline shifts towards opposite side) premature loss of tooth or teeth, proximal caries, missing tooth or teeth (where the midline shifts towards the same side).



Fig. 3.41: Note the deviation in the dental midline

- viii. Mobility/depressibility of teeth:** Mobility is checked using two blunt instruments such as the handle of the mouth mirror as shown in figure 3.42. Mobility is the labiolingual movement of the tooth whereas depressibility is the movement of the tooth in an apical direction. Based on the amount of tooth movement it can be graded as:

- First degree – barely visible
- Second degree – 1 mm Or less
- Third degree - > 1 mm Or vertical.

May be due to the purulent exudate in periapical region, advanced periodontal disease, horizontal root fracture in middle or coronal 1/3 or chronic bruxism.

PROVISIONAL DIAGNOSIS

Diagnosis is the art of identifying a disease from its signs and symptoms followed by thoughtful interpretation of the data.

Provisional diagnosis is a general diagnosis based on clinical impression without any laboratory investigation.



Fig. 3.42: Position of the instruments while checking the mobility of the tooth

INVESTIGATION

Percussion

- Reveals the status of the periodontium and not of pulp.
- During inflammation in the periodontal space the tooth is pushed coronally due to the exudate that gets accumulated. There is also pressure that is built due to continuous formation of exudate in a confined periodontal space. When the tooth is tapped the tooth is pushed back into the socket which stimulates the nerve ending present in the periodontal space causing pain. Thus pain on percussion means that the tissues in the periodontal space are inflamed.
- Children should be explained the steps involved during the test. They must be explained the difference between the sensation that is felt during tapping of a normal tooth and the actual pain. Normally children mistake the feel of tapping for pain.
- First a normal tooth must be percussed followed by the affected tooth. This helps in comparing the sensation felt by the child.
- Percussion should be done first lightly with index finger followed by the handle of the mouth mirror.
- Tapping on each cusp may at times reveal the presence of crown fracture.

Positive response to percussion may be due to:

- Teeth undergoing orthodontic movement.
- Recent high restoration.
- An apical or lateral periodontal abscess.

Radiographic Examination

- IOPA gives information regarding the presence or absence of permanent teeth, shape and position of the teeth present, relative state of development of teeth, extent of calcification of developing tooth, path of eruption of permanent teeth, morphology and inclination of the root of permanent tooth, etc.
- Crown, roots, root canal, lamina dura, bony architecture and other anatomic land marks should be examined for carious destruction, depth of restoration, internal resorption, incomplete apices, etc.
- If the canal appears to change quickly from dark to light it indicates bifurcated or trifurcated root canal.
- If the outline of the root is unclear or deviates, an extra root should be suspected.
- A great deal of bone destruction might have occurred before radiographic signs are evident. Loss of cancellous bone is undetectable until at least 66% of the mineral content of the cortical bone in the direct path of the X-ray beam has been lost. Hence a periapical lesion is usually larger than its radiographic image.
- Vertical fractures are difficult to identify.
- Horizontal fractures may be confused with bone trabeculae. This may be differentiated by noting that the lines of bone trabeculae extend beyond the border of the root, but a root fracture often causes a thickening of the PDL.
- Please refer the chapter no. 20 for further information of different types of radiographs and their indications.

Pulp Testing

This is not routinely used in children as their pain perception varies due to incomplete roots which are either resorbing or developing.. Objective of this test is to elicit a pulpal response for a particular stimuli. The stimuli can be thermal or electric.

Thermal

Heat or cold stimuli can be used. Preferred temperature for heat test is 65.5°C. Gutta percha stick, hot water, or heated instrument tip can be used as the source of



heat. Ethyl alcohol, ice sticks or carbon dioxide can be used as the source for applying cold stimuli.

Response to Vitality Testing

It may be nil, moderate transient, painful transient or painful lingering and each indicating the status of the pulp as follows:

- Nil = non-vital pulp or false -ve
- Moderate transient = normal
- Painful transient = reversible pulpitis
- Painful lingering = irreversible pulpitis

Electric Pulp Testing

- This test utilizes mild electric current to stimulate nerve and elicit a response.
- It is contraindicated in patients with pacemakers.
- False positive reading is observed with extensive vital restorations, anxiety, moist gangrenous pulp, and failure to isolate the tooth.
- False negative reading is observed with thick insulating base, recently traumatized tooth, incomplete root formation, excessive calcification, partial necrosis and patients taking sedatives.
- The main disadvantage of electric pulp tester is that it merely suggests whether the tooth is vital or not and does not provide information on the health, integrity or vascular supply of pulp.

Study Models and Model Analysis

- Model analysis is done to detect arch size and tooth size discrepancies.
- Study models should be neat and well detailed. Alveolar process should also be recorded.
- The top surface of upper model and lower surface of the lower base should be parallel when models are in occlusion.
- Midline of the palate is at right angles to the rear surface of the model.
- The base of the cast must be 25% of the total height of the cast and the remaining 75% is the anatomic details of the cast.

Photographs

Ideally extra-oral (frontal, right and left lateral of the face) and intra-oral (maxillary and mandibular occlusal and frontal occlusal) photographs are taken initially prior to any treatment. This pre procedural photographs serves as a record for later comparison. They also aid to study the facial symmetry, profile and facial type of the patient.

Cephalometric Study (Fig. 3.43)

Use of Cephalometrics

- Study of growth and development
- Case diagnosis
- Treatment planning
- Dictating the prognosis
- Studying the craniofacial abnormalities
- Prediction of growth.

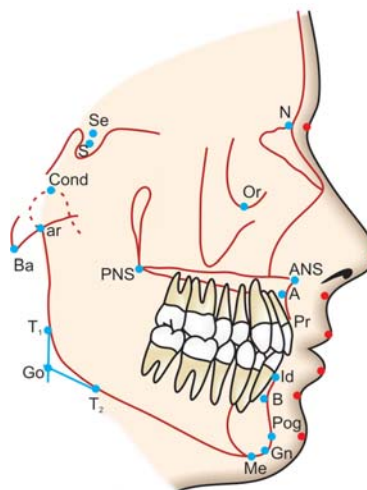


Fig. 3.43: Cephalometric points

N – Nasion; S – Sella; Se – Mid point of the entrance to sella; Cond – Condylion; Ar – Articulare; Ba – Basion; T1 – Most posterior point on ramus in the region of the angle of mandible; T2 – Most inferior and posterior point on the body of the mandible; Go – Gonion; Me – Menton; Gn – Gnathion; Pog – Pogonion; B – Point B; Id – Infradentale; Pr – Prosthion; A – Point A; ANS – Anterior nasal spine; PNS – Posterior nasal spine; Or – Orbitale



Cephalometric analysis

Skeletal

- ◆ SNA – To know the anteroposterior position of the maxilla in relation to the anterior cranial base.
 - Normal – 82°
 - Increased – prognathic maxilla
 - Decreased – retrognathic maxilla
- ◆ SNB – Anteroposterior positioning of mandible to anterior cranial base.
 - Normal – 80°
- ◆ ANB – Maxillo mandibular relation or skeletal base relationship
 - Class I – $2-4^\circ$
 - Class II – $> 4^\circ$
 - Class III – $< 2^\circ$
- ◆ Facial angle – Anteroposterior position of mandible in relation to FH plane
 - (Facial plane to FH plane)
 - Normal – 76°
 - Increased – Prognathic mandible
 - Decreased – Retrognathic mandible
- ◆ FMA – Frankfurt mandibular plane angle (FH plane to mandibular plane), gives the idea of mandibular growth pattern.
 - Average – 25°
 - Increased – high angle case (vertical growth pattern)
 - Decreased – low angle case (horizontal growth pattern)
- ◆ Y axis to FH plane (growth axis), indicates the type of growth which the mandible is likely to undergo.
 - Normal – 66°
 - Increased – vertical growth pattern
 - Decreased – horizontal or forward growth pattern

Dental

Assessment of upper incisors

- Upper incisors to NA plane in degree (22°) and in mm (4 mm)
 - Increased – proclined
 - Decreased – retroclined

Assessment of lower incisors

- Lower incisor NB plane in degree (25°) and in mm (4 mm)
 - Increased – proclined
 - Decreased – retroclined
- Inter incisal angle – Formed by the long axis of upper and lower incisors.
 - Normal – 131°

Supplemental Diagnostic Aids

- ◆ **Occlusal radiographic view** – used for location of impacted canine or mid palatal suture area
 - ◆ **Tube shift technique**
 - ◆ **PA view**
 - ◆ **EMG** – to conform the clinical diagnosis of muscle function, e.g. Class II division 1 is associated with hyperactive mentalis = 85-90 MV.
 - ◆ **BMR** – in hypothyroidism there is delayed eruption which may cause malocclusion and is associated with reduced BMR.
 - ◆ **Diagnostic set up** – teeth are removed and resembled replaced in position simulating the post-treatment position.
 - ◆ **Hand wrist radiograph**
 - Estimates the skeletal age.
 - Carpal bones, epiphysis, phalanges, metacarpals provide a clue to bone growth in the body as a whole.
 - Ossification occurs in these bones after birth and before maturity.
 - Inspection of carpal radiographs to assess the growth by evaluating the following – shape of the carpal bones, degree of ossification of the skeleton, time and order of appearance of carpals.
- The stage of mineralization of the carpal bones are determined. Then the development of metacarpal bones and phalanges are evaluated. Standard tables and analysis of Bjork are useful which divides the maturation process of bones of the hand between the 9th to 17th year into eight developmental stages. (Refer chapter 20 also)

Dental age: Can be estimated by the stage of tooth development, mineralization or eruption on a radiograph.

- ◆ Acceleration in dental development and eruption timing can be:
 - True-* endocrine disturbances, diabetes mellitus, etc
 - False-* early loss of deciduous teeth, inflammatory processes of alveolar bone
- ◆ Retardation in dental development and eruption timing can be:
 - True-* severe organic disease, prolonged periods of deficiency, endocrine disturbances, bone disease, environmental influence, etc.
 - False-* post traumatic situation, alveolar bone hyperplasia, fibrous gingival hyperplasia, etc.



FINAL DIAGNOSIS

It is a more confirmed diagnosis analyzing all the available data including the results of investigation.

TREATMENT PLANNING

Treatment planning is the orderly or sequentially arrangement of the various treatment needs of the patient to provide maximum benefit to the patient as a whole.

Advantages of Treatment Planning

1. Re-diagnosis at every visit is avoided.
2. Serial appointments can be given on the first day as the patients treatment needs are already planned in an sequential order.
3. Instruments can be prepared well in advance before the patients arrival for the treatment.
4. Total fee estimation can be done.

Treatment plan must be discussed with the parents and permission taken before performing any treatment on the child. Information relating to the following must be given:

- Dental need of their child including the treatment as well as the preventive measures.
- Amount of time required to perform the treatment.
- Total cost.

Sometimes it may be difficult to perform any treatment in the normal out patient clinical setup and may require hospitalization. Such condition includes,

- Very young child, < 2 years with rampant caries, where cooperation may be difficult to achieve
- Child with concurrent medical problem such as cystic fibrosis, chronic heart disease, kidney disease, etc.
- Child with congenital or developmental handicapping condition such as mental, emotional or physical.

Phases of Treatment Planning

Planning the treatment can be made based on five different phases:

- a. Medical phase
- b. Systemic phase
- c. Preventive phase

- d. Corrective phase
- e. Maintenance and recall

Medical Phase

In this phase patients with positive medical history are referred to pediatrician for evaluation and consent. It may also be required to modify the dosage or change a particular drug as per the requirement of the treatment.

Systemic Phase

Any medication given to modify dental treatment is included in this phase, such as premedication for behavior management or antibiotic prophylaxis to a child with congenital cardiac defect.

Preventive Phase

This phase is the first phase of treatment. It is aimed at providing preventive therapy to prevent or minimize dental disease. It includes:

- i. Oral prophylaxis and fluoride treatment
- ii. Pit and fissure sealant application
- iii. Oral hygiene counseling
- iv. Diet counseling
- v. Orthodontic consultation.

Corrective Phase

It includes providing treatment or management of the disease process:

- i. Extractions
- ii. Restorations
- iii. Minor surgical procedures
- iv. Space maintainers
- v. Minor orthodontic corrections
- vi. Prosthetic rehabilitation.

Maintenance and Recall

Patients are recalled at regular intervals following the completion of the required treatment. This is done as a preventive measure for early detection of disease and also for biannual topical fluoride application. Patients at high-risk are maintained at 2-3 months recall and low risk at 6 months recall.



Modification in Treatment Planning

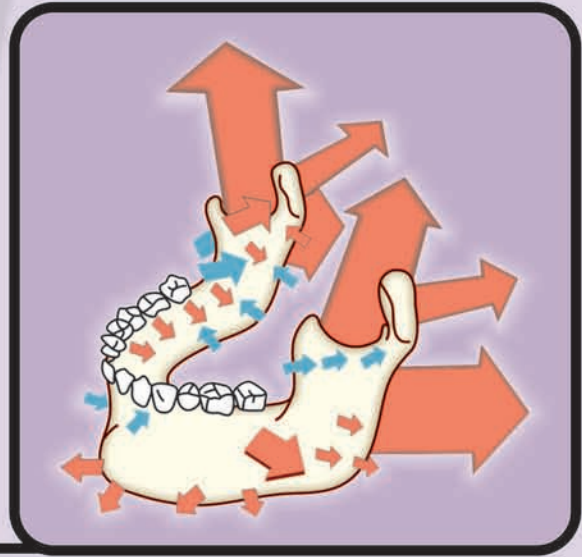
Treatment planning may be modified during the procedure based on the following:

1. Estimation of cooperation from the patient and parents.
2. Assessment of the condition of the teeth and the oral hygiene.
3. Whether extraction is needed or not.
4. Nature of tooth movement and type of appliance required.

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Chapter 4



Growth and Development

1. Definition
2. Factors Influencing Growth
3. Normal Human Growth
4. Growth Spurts
5. Measures of Growth
6. Practical Significance of Predicting Development
7. Mechanisms of Growth
8. Post-natal Growth and Development



DEFINITION

Growth is defined as an increase in mass, which means that it is a process that leads to an increase in the physical size of a cell, tissue organ or organism as a whole.

Development is defined as progress towards maturity. Growth and development go hand in hand and hence is most of the time dealt together.

FACTORS INFLUENCING GROWTH

1. Genetic factors
2. Maternal factors
3. Environment factors

Genetic Factors

Size at birth relates to about

- 18% to genome of the fetus
- 20% to the maternal genome
- 32% to the maternal environmental factors
- 30% to unknown factors

After birth, growth rate is primarily related to its own genetic make up. Thus neonates who are small for gestational age but have the genetic capacity to catch up to the normal range generally show accelerated growth within the first 6 months of post natal life. Size at birth correlates best with the size of the mother.

Maternal Factors

Role of uterine constraints or the size of the uterus: The fetus increases in size and fills the entire uterine cavity as it grows. During the last months the uterine constraints may limit the growth of the fetus.

Role of placenta: Placenta grows by increasing the cells until 35 weeks of gestation. Later the growth is due to increase in cell size. By 38-40 weeks of gestation the placenta reaches its full growth and later shows signs of deterioration or regression. So a post mature infant may be under weighed.

Socioeconomic factors: Lower the socioeconomic status the smaller is the size of the child.

Maternal health: Rubella, Rh incompatibility or other ill health affecting the mother will directly affect the development of the fetus.

Tobacco: Smoking is most damaging as it affects the fetal heart rate and alters the chemical content of the fetal blood.

Emotions: Fetal activity and heart rate increases in mild maternal stress. Severe and prolonged maternal stress lead to 'blood borne anxieties' which affects the post natal as well as prenatal development.

Nutrition: Fetus is able to obtain adequate nutrition for prenatal growth, even at the expense of depleting the mother. It therefore requires severe malnourishment in mother to have its effect on the child. Alcohol, if sparing used has no effect. If used frequently and heavily it is likely to damage the child's physical and mental development.

Endocrine factors: Endocrine disturbances in mother will directly influence the fetal growth. Example, maternal diabetes causes excessive fetal growth and thus an overweight baby.

Other maternal factors adversely affecting fetal growth are: Toxemia, hypertension, renal and cardiac diseases, use of exogenous agents such as ethanol, nicotine, hydantoin, warfarin etc.

Environmental Factors

1. Post natal growth and development of a child depends on both the genetic and environmental factors.
2. Environment factors that influence growth and development are socioeconomic factors, smoking, emotions, nutrition, endocrine factors and general health.

NORMAL HUMAN GROWTH

Pre-natal Phases

The time from conception to birth is described in 3 phases

1. Period of ovum
2. Period of embryo
3. Period of fetus

Period of Ovum (Conception -10 days)

- This period is from fertilization to implantation (upto 10-14 days)



- Rapid internal development is seen
- Implantation in the uterine wall occurs after about 10 days of fertilization.

Period of Embryo–2-8 Weeks

- Accessory apparatus like placenta, umbilical cord and amniotic sac develop during this period.
- External and internal features start to develop and function
- Sex can be identified.
- Growth in the head region is proportionally much greater than the rest of the body.
- By the end of this period the embryo measures 1½ to 2” in length.

Period of Fetus – 8-40 Weeks

- Growth continues
- Nerve cells that are present since the third week, increase rapidly in number during the second, third and fourth months.
- Internal organs assume nearly adult positions by fifth lunar month

The development of face begins during the 4th week of intrauterine life. It is seen as consisting of one frontonasal process, two maxillary processes and two mandibular processes.

Relation of maxilla to mandible during growth:

Embryonic stage - mandibular process is larger

Fetal stage – maxilla is more developed

By 11 weeks – mandible grows rapidly and equals maxilla

By 13-20th week – lag in mandibular growth

At birth – mandible seems to be retrognathic to maxilla

Intra uterine life is characterized by very rapid growth, with peak growth velocity at about the 4th month. The growth rate decreases during the last 5 months. Following birth, growth rate continues to decrease. This is the period when the infant makes adjustments for the maternal factors that influences birth length and weight.

Scammon's Growth Curve

It represents the differential growth of the body tissues. The lymphoid tissues, genital tissues, neural tissues grows at different rates and is different from the general growth of the other tissues of the body and is represented in a graph as in Fig. 4.1.

Lymphoid tissues grow during childhood. The growth of the neural tissues is complete at a early stage of life at about 7 years, whereas the growth of genital tissues begins only at puberty. The growth of the body in general comprising of skeletal system, muscles and the viscera grow and develop throughout from birth with periods of low and rapid growth throughout and represented as an 'S' curve in the graph.

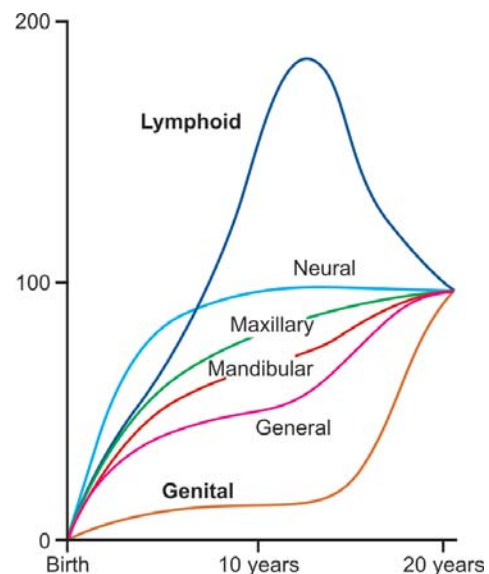


Fig. 4.1: Scammon's growth curve

Post-natal phases

Features seen at birth are (Fig. 4.2)

- Tiny mouth and small chin
- Small face, eyes appear big
- Forehead and top of the head are big
- Bones that compose the cranium are not fused
- Broad and flat face
- Underdeveloped mandible
- Cranium is nearest to adult size

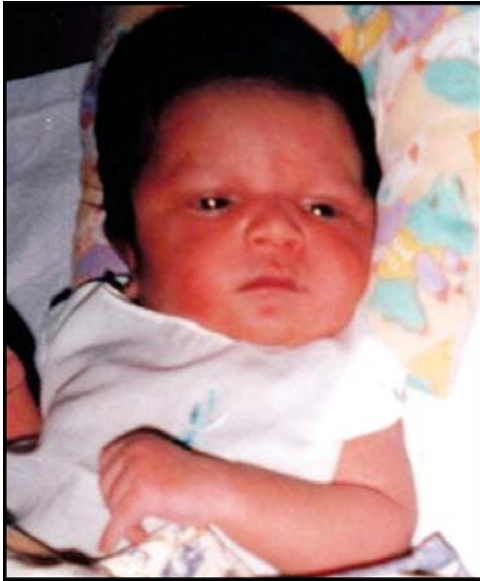


Fig. 4.2: Newborn baby

By 1 year, the infant is growing near the projected growth rate and by 2 years, the growth rate is dependent on the genetic make up of the child itself. From 2-3 years growth is slow and steady till puberty.

Growth of cranial vault is complete before that of maxilla. And maxillary growth is complete before mandibular growth.

3-6 Years

- Cartilage in the skeletal system is getting replaced by bone and all the bones become more calcified and harder.
- Face becomes larger, wider, longer and more detailed.
- It will become evident to some degree which children have natural athletic ability and which do not.
- Soft tissue prominence of nose and mandible continue to increase.
- Lowering of palatal vault is seen, due to sutural growth and apposition on the oral side of the palate and resorption on the nasal side.
- Transverse growth of the face comes to an end much earlier than other dimensions.

6-12 Years

Most remarkable proportional change in the body during these years results from the lengthening of the child's limbs. Boys are generally slightly taller and heavier than girls until around 10 years. From 10-15 years girls become slightly taller and heavier than boys for a brief period. Neural and cranial growth are found to be almost entering completion.

> 12 Years (Adolescence)

It is usually associated with puberty, which is the landmark in physical development when an individual becomes capable of sexual reproduction. It is paralleled by the development of genital tissue and secondary sexual characteristics. There is an increase in the mass of muscles, redistribution of body fat and increase in the rate of skeletal growth. A growth spurt is associated with this time of life.

GROWTH SPURTS

Growth does not occur uniformly throughout the life. Certain periods of life exhibit faster or more growth compared to other periods. Such bouts of sudden accelerated growth are termed as growth spurts.

Period of Growth Spurts

- a. Just before birth
- b. One year after birth
- c. Mixed dentition period – boys at 8-11 years and girls at 7-9 years
- d. Adolescent period – boys at 14-16 years and girls at 11-13 years.

Clinical Importance

Orthodontic appliances such as myofunctional appliances are usually prescribed during these growth spurt periods, taking advantage of the active growth. Orthopedic surgeries such as done for the correction of bimaxillary protrusion are done preferably after cessation of the growth, otherwise it may result in relapse and failure.



Influence of Hormones on Growth

Increase in growth rate—growth hormone, thyroxine, insulin

Decrease in growth rate—corticosteroids

Increase in skeletal ossification—parathormone, vitamin D, calcitonin

Increase in skeletal maturation and pubertal growth—thyroxine, gonadotropins, adrenal steroids

MEASURES OF GROWTH

Standard normal growth measures can be studied based on either cross sectional data or longitudinal data. Cross sectional data, compares the height of a child at a given time with the heights of other children in general population. Longitudinal study includes collection and comparing a single child over a period of time.

Growth Assessment Parameters

The parameters used to assess growth are:

1. Chronologic age
2. Biologic age
 - Morphologic age/height and weight age
 - Skeletal age
 - Dental age
 - Sexual age
3. Behavioral age
4. Facial age
5. Mental age

Chronologic Age

Chronologic age is calculated from the child's date of birth. This by itself is not an accurate indicator of stage of development, nor is it a good predictor of growth potential.

Height and Weight Age

A standard growth curve (Fig. 4.3) is used to assess and characterize a child's height, compared to that of children of the same chronologic age. The child's own growth curve can be expressed by constructing a growth velocity curve, plotting height increments per year for each chronologic age. Weight standard curves have been

constructed, although the abnormal variation in weight in otherwise normal children limits the usefulness of these curves as a sole indicator of development.

Skeletal Age

The areas of ossification are recognizable on a radiograph and can be compared to the normal sequence of developmental changes that occur from birth to adulthood.

A characteristic pattern of progression of ossification of epiphyseal centres can be identified. Each endochondral bone begins with a primary centre of ossification, which changes in shape, size and contour until fusion occurs. Any of the skeletal growth centres may be used, but the hand and wrist have been commonly used as the area may be easily radiographed with minimal radiation exposure to the rest of the body. The union of the epiphysis with their diaphysis occurs in a specific order, which in females is advanced by 3-4 years compared to that in males. Between the ages of 12.5 and 14 years the most active transformation of the epiphyseal cartilages occurs concurrently with peak height velocity. Please also refer chapter 20.

Skeletal age was found to be more highly correlated with menarcheal age than with height and weight. Menarche usually occurred soon after the fusion of the epiphysis of the distal phalanges with their shafts.

Dental Age

Dental age indicator involves recognizing the teeth clinically present in the oral cavity in comparison to dental eruption charts. It also involves scoring based on the amount of calcification, according to the amount of crown and root formation or based on the different stages of tooth development. Dental age can be very well calculated using Nolla's (Fig. 4.4) or Demirjian's method (Fig. 4.5).

1. Absence of crypt
2. Initial calcification
3. 1/3 rd of the crown completed
4. 2/3 rd of the crown completed
5. Crown almost completed
6. Crown completed

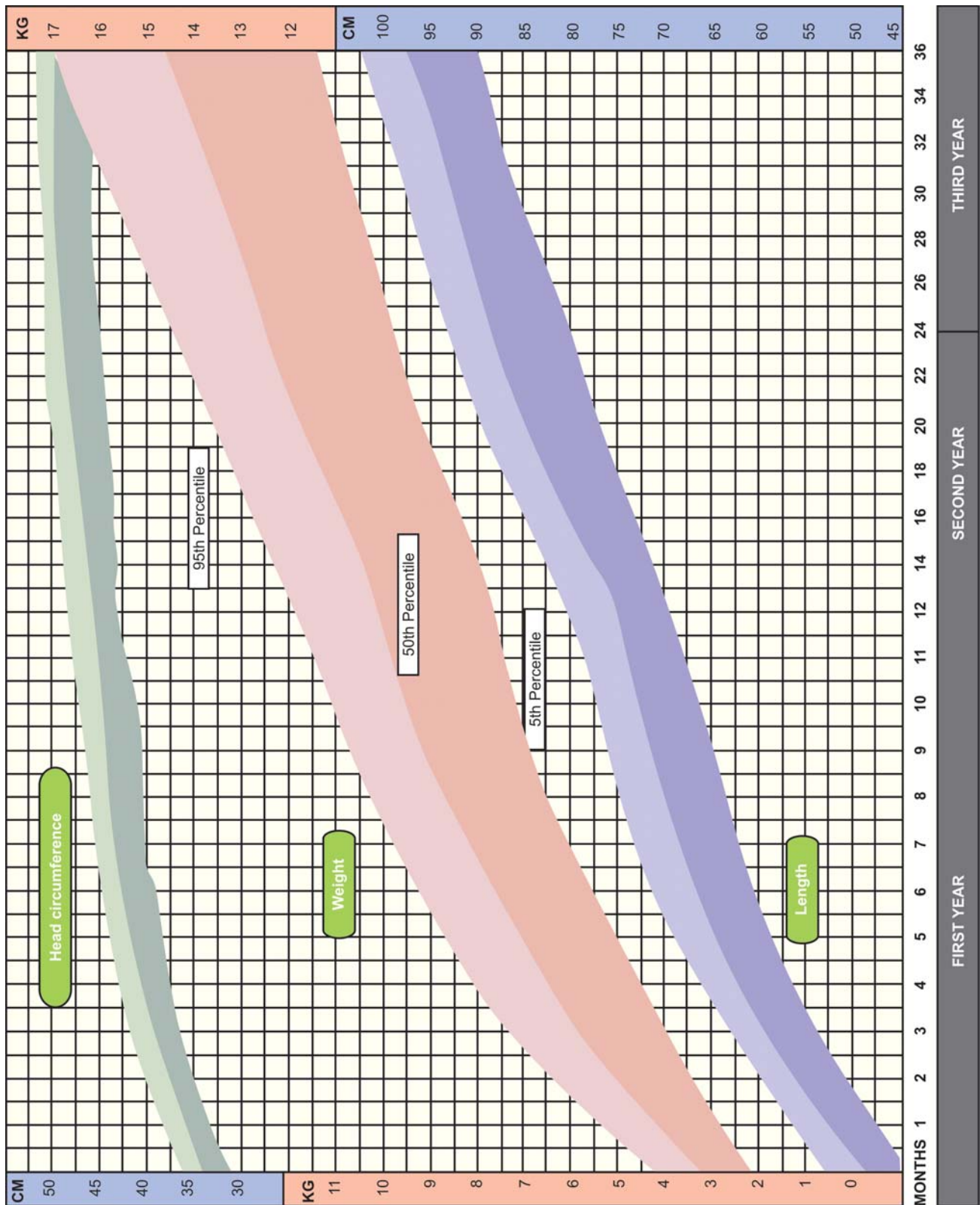


Fig. 4.3: Standard growth curve chart



7. 1/3 of root completed
8. 2/3 of root completed
9. Root almost completed
10. Apical end of root development completed

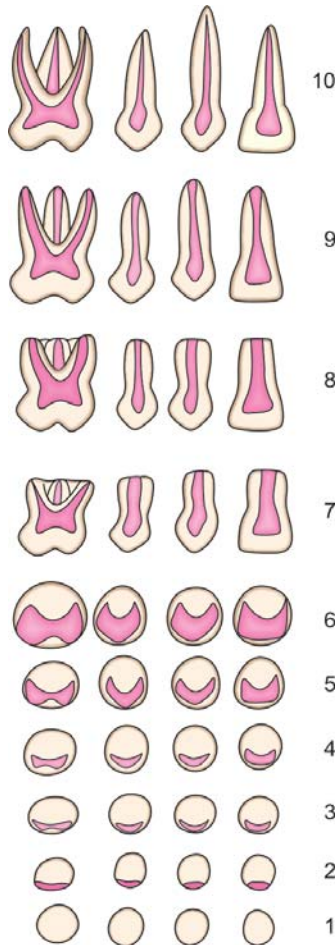


Fig. 4.4: Stages of development of teeth based on Nolla's method

Sexual Age

Tanner outlined stages of secondary sexual characteristics and their relation to the pubertal growth spurt in height categorizing them into 5 stages. Stage 1 is prepubertal and stage 5 is a mature adult.

Behavioral Age

It is based on the behavior of the patient, which can be social or activity based.



Fig. 4.5: Stages of tooth development used for calculating the dental age as per Demirjian's method.

A: Beginning of calcification seen at the superior level of the crypt in the form of inverted cone

B: Fusion of the calcified points to form the occlusal outline

C: Enamel formation is complete at the occlusal surface. Its extension and convergence towards the cervical region is seen

D: Crown formation is complete down to the cementoenamel junction

E: Initial formation of the root is seen

F: Bifurcation appears to give roots a more distinct outline

G: Walls of the root canal are parallel. Apical ends of the roots are open

H: Apical ends of the roots are closed.

Facial Age

It is an anthropometric measurements and development of a facial growth velocity curve using measurements



from serial cephalometric radiographs similar to the standard height curves.

Mental Age

Mental age is based on the I.Q. or understanding ability of the child. Any explanation given to children regarding the instruments or procedure should be done in accord with the mental age of the child.

PRACTICAL SIGNIFICANCE OF PREDICTING DEVELOPMENT

1. Mature size: It is possible to predict at a fairly early age what the child's adult physique will be.
2. Educational planning: Plans regarding education can be made based on the child's early intellectual aptitude.
3. Preparation for next stage: At every stage of development, the child can be prepared for the next stage.
4. Vocational planning: Early physical, intellectual and personality development gives clues as to what the child may be able to do vocationally in adulthood. These clues can be used by parents and teachers.

MECHANISMS OF GROWTH

Growth of facial skeleton is not a simple mechanism. There are no symmetrical enlargements but is associated with complicated differential growth mechanism.

The mechanisms important for bone growth in craniofacial regions are:

- A. Endosteal and periosteal bone growth
- B. Cortical drift
- C. Relocation and remodeling
- D. V' principle
- E. Surface principle
- F. Growth fields
- G. Displacement

Endosteal and Periosteal Bone Growth (Fig. 4.6)

When there is growth of a particular bone by the deposition of bone on the inner or endosteal surface

of the bone it is termed as endosteal bone growth. Similarly periosteal bone growth is seen when bone deposition occurs on the outside or in the periosteum. Both types of growth are seen in facial and cranial bones.

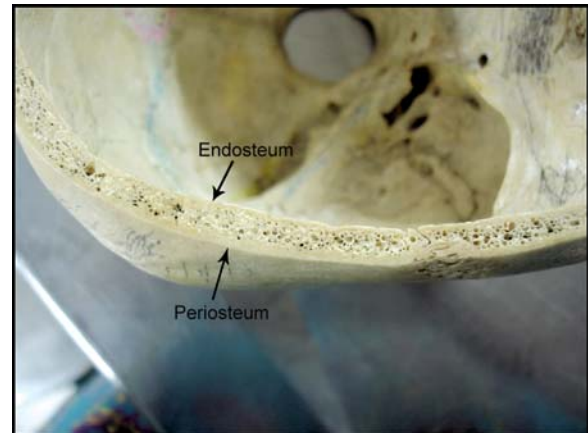


Fig. 4.6: Endosteum and Periosteum of the skull bone

Cortical Drift

All bone structures have one growth principle in common, termed as 'drift' by Enlow. The cortical plate drifts in the direction of growth by selective deposition on the outer side and resorption on the inner side. The rate of deposition and resorption is almost similar thus maintaining the thickness of the cortical plate. The teeth follow the drift of the alveolar bone while the jaws are growing and thus maintain their position within the surrounding bony structures despite the bone displacement.

Relocation and Remodeling

Due to new bone deposition on existing surface, all other parts of the structure undergo shifts in relative position, a movement which is termed as 'relocation'. As a result of this process, further adaptive bone remodeling is necessary in order to adjust the shape and size of the bone to the new relationship. Remodeling is based on relocation and is a secondary result of the displacement process.

The Expanding 'V' Principle (Fig. 4.7)

This principle is important to study the facial skeleton growth mechanism, since many facial and cranial bones have a 'V' configuration or 'V' shaped regions. Such



areas grow by bone resorption on the outer surface of the 'V' and deposition on the inner surface. The 'V' moves away from its tip and enlarges simultaneously. Thus increase in size and growth movements are a unified process resulting in enlargement in overall size, movement of the entire 'V' structure towards its own wide end leading to continuous relocation.

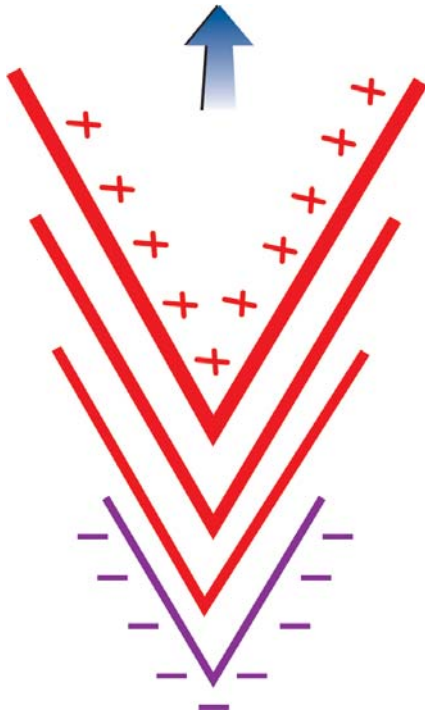


Fig. 4.7: Expanding 'V' principle of growth

Surface Principle (Fig. 4.8)

According to this, bone sides which face the direction of growth are subject to deposition and those opposite to it undergo resorption. The direction of growth is not the same for all the areas of the bone as each region of a structure has its own specific growth pattern.

Growth Fields

Bone growth is controlled by so-called growth fields. They are distributed in a characteristic pattern across the surface of a given bone and have either depository or resorptive activity. Growth fields have a pace making function, which is controlled by soft tissues. The soft tissues acts a functional matrix to control bone growth

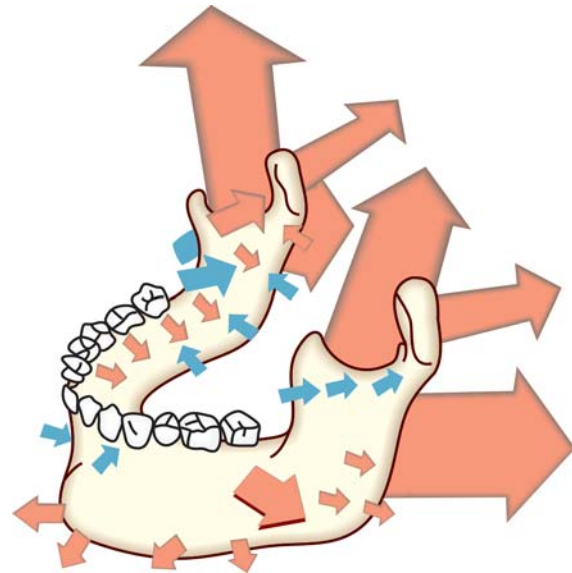


Fig. 4.8: Surface principle of growth

whereas the bone itself only reports, via a feed back mechanism which is connected to the connective tissues, when the shape, size and biomechanical aspects coincide with the functional requirement.

Displacement (Fig. 4.9)

Apart from direct bone growth due to deposition and resorption, the process of displacement, that is the translatory movement of the whole bone caused by the surrounding physical forces, is the second characteristic mechanism of skull growth. The entire bone is carried away from its articular interfaces with adjacent bones.

Displacement in conjunction with bones own growth is termed 'primary displacement' by Enlow. The degree of displacement exactly equals the amount of newbone deposition, although the direction of displacement is always opposite to that of bone deposition. Bone displacement due to the enlargement of bones and soft tissues which are nearby or not immediately adjacent is termed 'secondary displacement'

FUNCTIONAL MATRIX THEORY

Osteogenesis is mostly influenced by local functional demands. For example, an increase in the size of the brain influences the increase in size of the cranium.

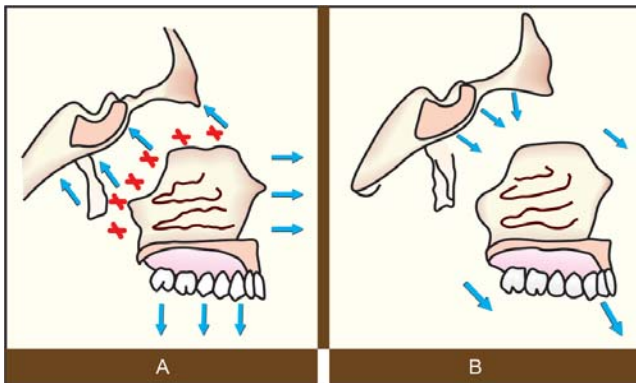


Fig. 4.9: Displacement

Each component of the bone consists of two parts, the functional matrix and the skeletal unit. Functional matrix includes functioning spaces and the soft tissue components required for a specific function. The functional matrix carries out a given function, whereas the skeletal units such as bone and cartilage protect and support the functional matrix and are adaptable.

There are two types of functional matrices, the periosteal matrix and the capsular matrix. Periosteal matrix is best represented by muscle attachment. Capsular matrices are divided into three types, the neurocranial, orbital and orofacial.

The capsular and periosteal matrices have a completely different effect on the growth processes. Capsular matrix exerts a direct influence on the macroskeletal units and functional cranial components. It is responsible for changes in the 3 dimensional position of the skeletal unit. Periosteal matrix exerts direct influence on the microskeletal unit and the functional cranial components or perichondral or endochondral growth processes. Thus the periosteal matrix changes the shape and size of the corresponding microskeletal unit.

POST-NATAL GROWTH AND DEVELOPMENT

Post-natal Growth of The Cranium

The growth processes occurring at the cranial base, maxilla and the mandible are all related to each other at various sutures and the temporo-mandibular joint.

The cranial base grows post-natally by complex interaction between the following three growth processes.

A. Extensive cortical drift and remodeling

B. Elongation at synchondroses

C. Sutural growth

Cortical drift and remodeling

Remodeling is a process where bone deposition and resorption occur that brings about change in size, shape and relation ship of the bone.

The elevated ridges and bony partitions in the cranial base show bone deposition.

The predominant part of the floor shows bone resorption, which helps in increasing the intracranial space to accommodate the growing brain.

The cranial base is perforated by the passage of a number of blood vessels and nerves communicating with the brain. The foramina that allow the passage of these nerves and blood vessels undergo drifting by bone deposition and resorption so as to constantly maintain their proper relationship with the growing brain.

Elongation at the Synchondrosis

Most of the bones of the cranial base are formed by a cartilaginous process. Later the cartilage is replaced by bone. However small parts of cartilage may remain at the junction of various bones. These areas are called synchondroses. They are important growth sites of the cranial base. The important synchondroses found in the cranial base are (Fig. 4.10).

A. Spheno-occipital synchondrosis

B. Spheno-ethmoid synchondrosis

C. Inter-sphenoid synchondrosis

D. Inter-occipital synchondrosis

Spheno-occipital synchondrosis: It is a cartilaginous junction between the sphenoid and the occipital bones. The spheno-occipital synchondrosis is the principal growth cartilage of the cranial base during childhood and is active up to the age of 12-15 years. The sphenoid and the occipital segments then become fused in the midline by the age of 20 years.

Since the direction of growth of the spheno-occipital synchondrosis is upwards, it carries the anterior part of the cranium bodily forwards.

Spheno-ethmoid synchondrosis: This is a cartilaginous band between the sphenoid and ethmoid bones. It ossifies at later years of age.



Inter-sphenoidal synchondrosis: It is a cartilaginous band between the 2 parts of the sphenoid bone. It ossifies at birth.

Intra-occipital synchondrosis: This ossifies by 3-5 years of age.



Fig. 4.10: Positions of the important Synchondroses of the cranial base

- A. Spheno-occipital synchondrosis
- B. Spheno-ethmoid synchondrosis
- C. Inter-sphenoid synchondrosis
- D. Inter-occipital synchondrosis

Sutural Growth

The cranial base has a number of bones that are joined to one another by means of sutures. Some of the sutures that are present and influence the growth of the cranium are (Fig. 4.11):

1. Spheno-frontal suture
2. Fronto-temporal suture
3. Spheno-ethmoid suture
4. Fronto-ethmoid suture
5. Fronto-zygomatic suture

Timing of cranial base growth

- A. By birth, 55-60% of adult size is attained.
- B. By 4-7 years, 94% of adult size is attained.
- C. By 8-13 years, 98% of adult size is attained.



Fig. 4.11: Important sutures at the cranial base

- A. Spheno-frontal suture
- B. Spheno-ethmoid suture
- C. Fronto-ethmoid suture

Post-Natal Growth of Maxilla

The growth of the naso-maxillary complex is produced by the following mechanisms:

- A. Displacement
- B. Growth at sutures
- C. Surface remodeling

Displacement

Maxilla is attached to the cranial base by means of a number of sutures. Thus the growth of the cranial base has a direct bearing on the naso-maxillary growth.

Naso-maxillary complex grows in a downward and forward direction as the cranial base grows. This is referred to as secondary displacement, as the actual enlargement of these parts is not directly involved. The passive displacement of the maxilla is an important growth mechanism during the primary dentition years but becomes less important as growth of cranial base slows.

Primary type of displacement is also seen, in a forward direction. This occurs by growth of the maxillary



tuberosity in a posterior direction resulting in the whole maxilla being carried anteriorly. The amount of this forward displacement equals the amount of posterior lengthening.

Growth at sutures

The maxilla is connected to the cranium and cranial base by a number of sutures.

These sutures include (Fig. 4.12)

1. Fronto—nasal suture
2. Fronto—maxillary suture
3. Zygomatico—temporal suture
4. Zygomatico—maxillary suture
5. Ptergo—palatine suture



Fig. 4.12: Important sutures through which maxilla is connected to the cranial base

- A. Fronto—nasal suture
- B. Fronto—maxillary suture
- C. Zygomatico—temporal suture
- D. Zygomatico—maxillary suture

These sutures are all oblique and more or less parallel to each other, which allows the downward and forward repositioning of the maxilla as growth occurs at these sutures. As growth of the surrounding soft tissue occurs, the maxilla is carried downwards and forward. This leads to opening up of space at the sutural attachments. Newbone is now formed on either side of the suture. Thus the overall size of the bones on either side increases.

Surface Remodeling

In addition to the growth occurring at the sutures, massive remodeling by bone deposition and resorption occurs to bring about,

1. Increase in size
2. Change in shape of bone

3. Change in functional relationship

It is characterized by:

- Resorption occurs on the lateral surface and deposition on the medial rim of the orbit.
- Bone deposition occurs along the posterior margin of the maxillary tuberosity. This causes lengthening of the dental arch and enlargement of the antero-posterior dimension of the entire maxillary body. This helps to accommodate the erupting molars.
- Bone resorption occurs on the lateral wall of the nose leading to an increase in size of the nasal cavity.
- Bone resorption is seen on the floor of the nasal cavity and there is bone deposition on the palatal side. Thus a net downward shift occurs leading to increase in maxillary height.
- Resorption on the anterior surface and deposition on the posterior surface of the zygomatic bone results in the movement of the bone in a posterior direction.
- The face enlarges in width by bone formation on the lateral surface of the zygomatic arch and resorption on its medial surface.
- The anterior nasal spine prominence increases due to bone deposition. In addition there is resorption from the periosteal surface of labial cortex. As a compensatory mechanism, bone deposition occurs on the endosteal surface of the labial cortex and periosteal surface of the lingual cortex.
- As the teeth start erupting, bone deposition occurs at the alveolar margins. This increases the maxillary height and the depth of the palate.
- The entire wall of the sinus except the mesial wall undergoes resorption. This results in increase in size of the maxillary antrum.

Post-Natal Growth of Mandible (Fig. 4.13)

Developmentally and functionally the mandible is made of several skeletal sub-units. The basal bone or the body of the mandible forms one unit, to which is attached the alveolar process, the coronoid process, the condylar process, the angular process, the ramus, the lingual tuberosity and the chin. Thus the study of post-natal growth of the mandible is made easier and more meaningful when each of the developmental and functional parts are considered separately.

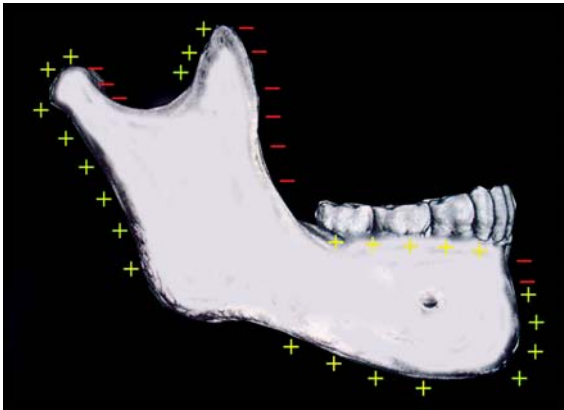


Fig. 4.13: Areas of bone deposition (+) and resorption (–) in mandible

The right and the left halves of the mandible fuses by one year after birth. Chin prominence increases as the child grows along with lengthening of the body of the mandible.

The ramus moves progressively posteriorly by a combination of deposition and resorption. Resorption occurs on the anterior part of the ramus, while bone deposition occurs on the posterior region. This results in a 'drift' of the ramus in a posterior direction, which aids to

- Accommodate the increasing mass of masticatory muscles inserted into it.
- Accommodate the enlarged width of the pharyngeal space.
- Facilitate the lengthening of the mandibular body, which in turn accommodates the erupting molars.

This results in the conversion of former ramus bone into the posterior part of the body of mandible. In this manner the body of the mandible also lengthens. Thus the additional space made available by means of resorption of the anterior border of the ramus is made use of to accommodate the erupting permanent molars.

Resorption also takes place on the postero-inferior aspect of the angle of mandible while deposition occurs on the antero-superior aspect on the lingual aspect. On the buccal side, resorption occurs on the anterior-superior part and deposition occurs on the postero-superior aspect. This result in flaring out of the angle of the mandible as age advances.

The lingual tuberosity moves posteriorly by deposition on its posteriorly facing surface. The prominence of the

tuberosity is increased by the presence of a large resorption field just below it. This resorption field produces a sizable depression, the lingual fossa and deposition on the medial surface of the tuberosity itself accentuates the prominence of the lingual tuberosity.

Alveolar process develops in response to the presence of tooth buds. As the teeth erupt the alveolar process develops and increases in height by bone deposition at the margins. The alveolar bone adds to the height and thickness of the body of the mandible and is particularly manifested as a ledge extending lingual to the ramus to accommodate the 3rd molars. In case of absence of teeth, the alveolar bone fails to develop and it resorbs in the event of tooth extraction.

At birth the chin is usually under-developed. As age advances the growth of chin becomes significant and is influenced by sexual and specific genetic factors. Usually males have prominent chins compared to females. The mental protuberance forms by the deposition of bone during childhood.

The growth of the coronoid process follows the enlarging 'V' principle. Viewing, the longitudinal section of the coronoid process from the posterior aspect, it can be seen that deposition occurs on the lingual (medial) surfaces of the left and right coronoid process. There is also associated increase in the height of the coronoid process.

Viewing it from the occlusal aspect, the deposition on the lingual of the coronoid process brings about a posterior growth movement in the 'V' pattern.

The mandibular condyle forms an important growth site. The head of the condyle is covered by a thin layer of cartilage called the condylar cartilage. The role of the condyle in the growth of mandible has remained a controversy, there are two schools of thought regarding the role of the condyle.

- A. It was earlier believed that growth occurs at the surface of the condylar cartilage by means of bone deposition. Thus the condyle grows towards the cranial base. As the condyle pushes against the cranial base, the entire mandible gets displaced forwards and downwards.
- B. It is now believed that the growth of soft tissues including the muscles and connective tissues carries



the mandible forwards away from the cranial base (carry away phenomenon). Bone growth follows secondarily at the condyle to maintain constant contact with the cranial base.

Growth and development of the face is a combination of the growth of the entire cranium, the maxilla and the mandible. If there is hinderance in this growth in any one of the complexes it can result in serious deformity in the entire facial skeleton. Common example is the early synostosis of the cranial sutures results in syndromes such as Crouzon's or the Aperts Syndrome characterized by severe changes in the cranium as well in the orbit, nose, maxilla and mandible.

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Chapter 5



Development and Eruption of Teeth

1. Development of Teeth
 - Bud stage / initiation
 - Cap stage / proliferation
 - Bell stage / morpho and histodifferentiation
 - Advanced bell stage / apposition
2. Root Formation
3. Tooth Eruption
 - Factors influence the timing of eruption
 - Sequence of eruption and its clinical importance
 - Eruption movements
 - Problems during eruption of teeth



DEVELOPMENT OF TEETH

The development and subsequent eruption of the teeth is a complex procedure that occurs simultaneously with the growth and development of the entire facial complex. The development of teeth starts at about 5-6 intrauterine week, in the primitive oral cavity also called as stomodeum which is lined with low squamous cells that forms the oral ectoderm. The cells that underlie the oral ectoderm are neural crest or ectomesenchymal in origin.

Initially at this stage neither the upper nor the lower jaws show separate lip or gum region. The separation lips and cheeks from the gums are closely related with the development of the teeth. As the primordial of the teeth appears and develop, the cells of the oral epithelium thickens in the region of the lip, cheek, vestibule of the mouth and the site of the origin of dental lamina to form the primary epithelial band which gives rise to vestibular lamina and dental lamina. Vestibular lamina forms the vestibule.

The dental lamina is a band of epithelium that invades the underlying ectomesenchyme along each of the dental arches. The dental lamina serves as a primordium for the ectodermal portion of the teeth. The total activity of dental lamina extends over a period of at least 5 years, except in the third molar region where its activity is prolonged. As the tooth develops they loose their connection with the dental lamina and break up by mesenchymal invasion. Remnants of dental lamina persist as epithelial pearls or islands within the jaw and in the gingiva.

The development of teeth can be studied by dividing it into different stages based on the shape they acquire during development or based on physiologic changes they undergo as follows:

Based on change of shape, the tooth development can be divided as:

1. Bud stage
2. Cap stage
3. Bell stage
4. Advanced bell stage

Based on physiologic changes, the tooth development can be divided as:

1. Initiation

2. Proliferation
3. Morpho and histodifferentiation
4. Apposition.

Bud Stage/Initiation

The first epithelial invasion into the mesenchyme of the jaw to form a tooth occurs that resembles a bud and is called as enamel organ (Fig. 5.1). Different teeth are initiated at different and definite time. Enamel organ forms the enamel of the tooth. Lack of initiation results in the absence of tooth development leading to congenitally missing tooth and conversely abnormal initiation may lead to supernumerary teeth as well.

The initiation processes occurs along each jaws which marks the beginning of development of deciduous teeth. The timing will differ for anterior teeth and the posterior teeth. Anterior teeth develop earlier than the posterior teeth.

As the formation of the enamel organ continuous the ectomesenchymal cells below this increase in number and appear denser than the surrounding mesenchyme to form the dental papilla. The dental papilla and the enamel organ are surrounded by dental sac. The tooth bud at this stage lie close to the oral epithelium.

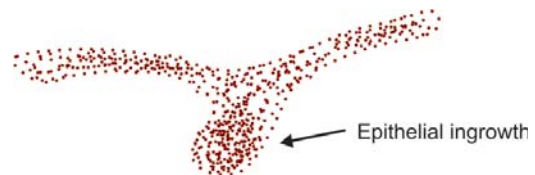


Fig. 5.1: Bud stage of tooth development: Condensation of the ectomesenchyme leading to bud shaped epithelial ingrowth

Cap Stage/Proliferation

As the growth continues regular changes in the size and proportion of the growing tooth germ is seen leading to the formation of a cap shaped enamel organ, characterized by a shallow invagination on the deep surface of the bud (Fig. 5.2). The enamel organ at this stage consists of 3 layers, enamel knot and enamel cord. The three layers are the outer enamel epithelium, inner enamel epithelium and stellate reticulum.



- i. *Outer enamel epithelium*: Cuboidal cells covering the convexity.
- ii. *Inner enamel epithelium*: Tall columnar cells in the concavity.
- iii. *Stellate reticulum*: These are polygonal cells in the centre between the outer and the inner enamel epithelium. They tend to separate as inter cellular fluid is produced and assume a branched reticular form. This layer acts as a cushion which supports and protects the delicate enamel forming cells.
- iv. *Enamel knot*: Densely packed cells in the centre of the enamel organ.
- v. *Enamel cord*: Vertical extension of the enamel knot extending to the outer enamel epithelium.

The dental papilla shows active budding of capillaries. The peripheral cells adjacent to inner enamel epithelium enlarge and later differentiate into odontoblasts.

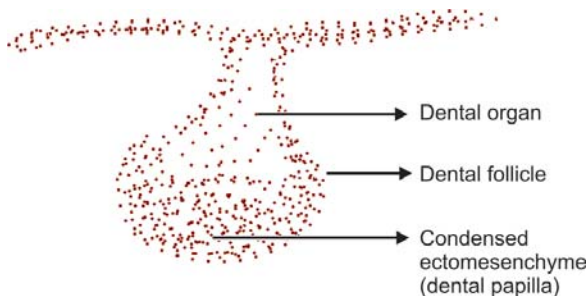


Fig. 5.2: Cap stage of tooth development: The dental organ assumes the shape of a cap and overlies the dental papilla

Bell Stage/Morpho and Histodifferentiation

In this stage, cells undergo definite morphologic as well as functional changes and acquire appositional growth potential. This phase reaches its highest development in the bell stage just before the beginning of enamel and dentin formation (Fig. 5.3).

At this stage the enamel organ consists of 4 layers, they are:

- i. Inner enamel epithelium, made of single layer of tall columnar cells called as ameloblasts.
- ii. Stratum intermedium, consisting of Squamous cells. This layer is essential for enamel formation along with inner enamel epithelium cells.
- iii. Stellate reticulum, are star shaped and secrete glycosaminoglycans.

- iv. Outer enamel epithelium, the cells flatten to a low cuboidal form.

The peripheral cells of the dental papilla differentiate into odontoblasts that form the dentin.

The dental sac initially shows a circular arrangement of its fibres resembling a capsular structure and later as the root development continues differentiates into periodontal fibres.

At the last stages of bell stage, the cervical portion of the enamel organ give rise to the epithelial root sheath of Hertwig. The inner and outer enamel epithelium meet each other at the rim of the enamel organ-junctional zone known as cervical loop.

The cells forming ameloblasts are tall columnar, 4-5 μm in diameter and 40 μm high. These cells are attached to each other by functional complexes and to stratum intermedium by desmosomes. The nucleus is centrally located, cytoplasm contains free ribosomes, few endoplasmic reticulum, mitochondria, Golgi complex and increased glycogen content.

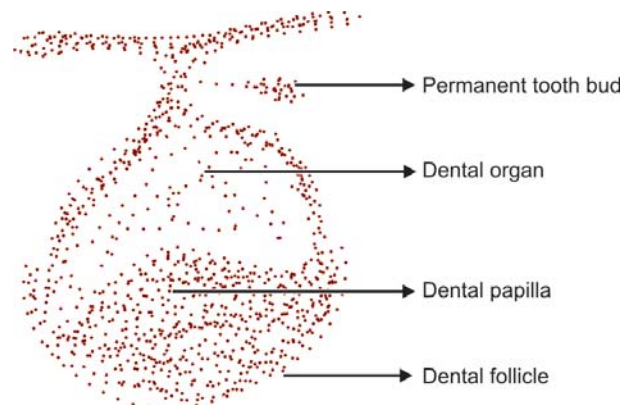


Fig. 5.3: Bell stage of tooth development: The undersurface of the dental organ deepens, giving it a bell shape

Advanced Bell Stage/Apposition

In this stage there is deposition of the matrix of the dental hard tissues in a layer like pattern and is additive (Fig. 5.4).

ROOT FORMATION

- Begins after enamel and dentin formation has reached the future cemento-enamel junction.
- The outer and inner enamel epithelium blend at the future cemento-enamel junction into a horizontal

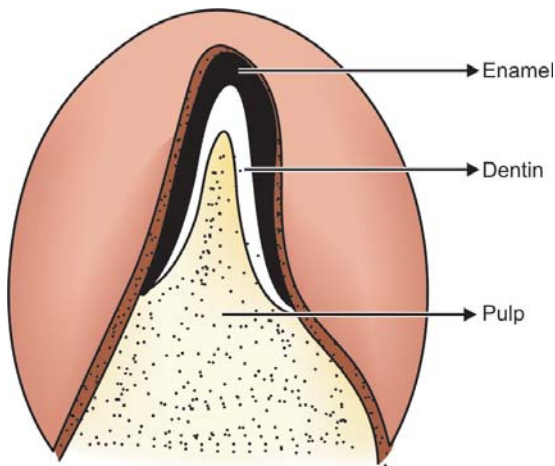


Fig. 5.4: Advanced bell stage of tooth development: Dental lamina is disintegrating. The crown pattern of the tooth is established by folding of the inner dental epithelium

plane to form the epithelial diaphragm. This narrows the wide cervical opening of the tooth germ.

- Hertwig's epithelial root sheath moulds the shape of the root and initiates radicular dentin formation.
- Hertwig's epithelial root sheath cells lose their structural continuity and close relation to the surface of the root, when the first layer of dentin has been laid down.
- At the last stages, the wide apical foramen is reduced first to the width of the diaphragmatic opening itself and later is further narrowed by apposition of dentin and cementum to the apex of the root. Differential growth of the epithelial diaphragm in multirooted teeth causes the division of the root trunk into 2 or 3 roots.

Early development and calcification of primary teeth
First macroscopic indication of morphologic development
—11 -12 ½ I. U week

Incisors begin to develop morphologic characteristics—
13-14 I.U week

Canines begin to develop morphologic characteristics—
14-16 I.U week

Initial calcification of incisors—16 I.U week

Initial calcification of canines—17 I.U week

First evidence of calcification of first molar—15 ½ I.U week

First evidence of calcification of second molar—18-19 I.U week

During the development, if the cells of the epithelial root sheath remain adherent to the dentin surface, they may differentiate into fully functioning ameloblasts and produce enamel called as enamel pearls.

Permanent Dentition

The permanent tooth develops from the dental lamina as the result of the proliferative activity within the dental lamina at a point where it joins the dental organ of deciduous tooth germ. This leads to the formation of another epithelial cap and associated ectomesenchymal response on the lingual aspect of the deciduous tooth germ.

The entire deciduous dentition is initiated between 5th-8th intrauterine week. The successional permanent teeth are initiated between 20th intra-uterine week to 10th post-natal month. The permanent first molar is initiated at the 20th intra-uterine week and the second permanent molar at the 5th year of life.

Time scale of human tooth development:

Dental lamina formation - 42-48 I.U day

Duration ↓ 8-10 Days

Bud stage of deciduous incisors, canine and molars- 55-56 I.U day

Duration ↓ 43 Days

Bell stage of deciduous teeth- 14th week

Duration ↓ 28 Days

Dentin and functional ameloblasts seen in deciduous teeth- 18th week

TOOTH ERUPTION

The process of eruption involves the movement or change of position of the tooth from the deeper portion of the jaws into the oral cavity until it achieves occlusal contact with adjacent and opposing teeth.

Factors Influence the Timing of Eruption

1. Genetic factor
2. Sex
3. Socioeconomic conditions
4. Birth weight
5. Systemic disorders
6. Hormones and vitamins
7. Local causes



CHRONOLOGY OF HUMAN DENTITION

Eruption of Tooth

Dentition	Jaw	Tooth	First evidence of calcification	Crown completion	Eruption	Root completion
Deciduous	Upper	Central Incisor	3-4 months I.U	4 months	7 ½ months	1 ½ - 2 years
		Lateral Incisor	4 ½ months I.U	5 months	8 months	1 ½ - 2 years
		Canine	5 ¼ months I.U	9 months	16-20 months	2 ½ -3 years
		First Molar	5 months I.U	6 months	12-16 months	2-2 ½ years
		Second Molar	6 months I.U	10-12 months	20-30 months	3years
	Lower	Central Incisor	4 ½ months I.U	4 months	6 ½ months	1 ½ - 2 years
		Lateral Incisor	4 ½ months I.U	4 ¼ months	7 months	1 ½ - 2 years
		Canine	5 months I.U	9 months	16-20 months	2 ½ -3 years
		First Molar	5 months I.U	6 months	12-16 months	2-2 ½ years
		Second Molar	6 months I.U	10-12 months	20-30 months	3years
Permanent	Upper	Central Incisor	3-4 months	4-5 years	7-8 years	10 years
		Lateral Incisor	10 months	4-5 years	8-9 years	11 years
		Canine	4-5 months	6-7 years	11-12 years	13-15 years
		First Premolar	1 ½ -1 ¾ Years	5-6 years	10-11 years	12-13 years
		Second Premolar	2-2 ½ Years	6-7 years	10-12 years	12-14 years
		First Molar	At birth	2 ½ -3 years	6-7 years	9-10 years
		Second Molar	2 ½ -3 years	7-8 years	12-13 years	14-16 years
		Third Molar	7-9 years	12-16 years	17-21 years	18-25 years
	Lower	Central Incisor	3-4 months	4-5 years	6-7 years	9 years
		Lateral Incisor	3-4 months	4-5 years	7-8 years	10 years
		Canine	4-5 months	6-7 years	9-10 years	12-14 years
		First PreMolar	1 ¾ -2 years	5-6 years	10-12 years	12-13 years
		Second PreMolar	2 ¼ -2 ½ years	6-7 years	11-12 years	13-14 years
		First Molar	At birth	2 ½ -3 years	6-7 years	9-10 years
		Second Molar	2 ½ -3 years	7-8 years	11-13 years	14-15 years
		Third Molar	8-10 years	12-16 years	17-21 years	18-25 years

Genetic Factor

Genes play a definite role in tooth eruption and has been estimated to be about 78%.

Sex

Teeth of girls erupt slightly earlier than those of boys. The average amount of tooth development for girls is about 3% ahead that of boys. The difference may vary from 2 months [First molar] to 10 months [maxillary canine].

Socioeconomic Condition

Socioeconomic levels are known to affect eruption. Retarded eruption of anterior teeth and accelerated emergences of the posterior dentition has been linked to low socioeconomic status in all racial groups.

Birth Weight

Low birth weight has been associated with delayed emergence of permanent teeth and conversely early eruption has been associated with increased birth weight.

Systemic Disorders

Precocious eruption is rare and is observed less commonly than retarded eruption.

Delay in permanent tooth eruption is associated with Down's syndrome, cleidocranial dysostosis, hypothyroidism, hypopituitarism and hemifacial atrophy.

Precocious eruption is seen in precocious puberty, hyperthyroidism, hemifacial hypertrophy, Sturge-Weber syndrome and hyperpituitarism.



Hormones and Vitamins

Thyroid, Pituitary [Growth Hormone], and Parathyroid hormones are essential for normal eruption of teeth. Vitamins like Vitamin B Complex, A, C and D aid either directly or indirectly for tooth eruption.

Local Causes

Ankylosis of primary teeth, delays the eruption of permanent tooth.

Dental caries and periapical infection of primary teeth, resulted in early eruption of the corresponding permanent tooth.

Very early extraction of a primary molar—delays gingival eruption of the successor.

Time required for a tooth to reach occlusion after piercing the gingival tissue varies from 3–30 months.

Root completion is complete approximately 1½ years for deciduous teeth and 3 years for permanent teeth after eruption.

Sequence of Eruption

The mandibular I permanent molars are often the first permanent teeth to erupt. The most favorable sequence of eruption of permanent teeth in the mandible is first molar, central incisor, lateral incisor, canine, first premolar, second premolar and second molar.

In maxilla the sequence is as follows, the first molar, central incisor, lateral incisor, first premolar, second premolar, canine and second molar.

This sequence of eruption is important to maintain arch length adequacy. For example, if the premolars erupt first there is a tendency for them to tip mesially due to extra space (Mesiodistal width of premolars is less than the mesiodistal width of the deciduous molars) and thus causing loss of arch length.

All mammals have gomphosis type of tooth attachment to the jaws but the eruption process or mechanism differs. There are three basic mechanisms of tooth eruption in mammals.

1. *Continuously growing tooth:* There is no separation between anatomical crown and root. Continuous growth of the tooth at the apex and continuous

eruption occur throughout the life of the animal. Clinical crown is constantly replaced by a root covered with enamel in progressive stages of development. With the loss of tooth substance due to occlusal attrition more tooth substance is extruded from the socket to maintain clinical crown. E.g. rodent incisor teeth.

2. *Continuously extruding tooth:* There is a definite crown and anatomical root. The tooth begins erupting by partially emerging from the investing tissue, revealing only a fraction of the large enamel surface. The enamel beneath the gingiva is covered with cementum enabling supraalveolar fibres to be attached to the tooth. As the tooth wears off, more of the anatomical crown extrudes and the epithelial attachment migrate apically, but since no new tooth structure is being formed, the continuous tooth eruption results in a gradual loosening and final exfoliation of the tooth, E.g. lower incisors of sheep and cattle.
3. *Continuously erupting teeth:* Mild amount of tooth extrusion occurs throughout with resultant addition of alveolar bone at the base of the socket. E.g. Human teeth.

Rate of eruption of human teeth — 140 mm/day during the most rapid period i.e. during the time of gingival emergence and 5 mm/day as the teeth reaches occlusal plane.

In a radiographic study it was found that the interval between crown completion and beginning of eruption until the tooth is in full occlusion is approximately 5 years for permanent teeth.

Eruption Movements

The eruptive movements of tooth can be divided as:

1. Pre-eruptive tooth movement
2. Eruptive movements
3. Post-eruptive tooth movements

Pre-eruptive Movements

These are the movements made within the bone before the tooth begins to erupt.

Development of the tooth and jaws occurs simultaneously. As the jaw grows the developing teeth



are carried along in their direction of growth. Thus the deciduous molar tooth germ moves or is carried in a backward direction the anterior tooth germ in a forward direction.

Pre-eruptive movements are combination of 2 factors.

- A. Total bodily movement
- B. Growth in which one part of the tooth germ remains fixed while the rest continues to grow leading to change in the center of the tooth germ. This explains how the deciduous incisors maintain their position relative to the oral mucosa as the jaws increase in height.

Eruptive Movements

Eruption normally starts when the root formation begins. The periodontal ligament develops only after root formation has been initiated and once established, it is remodeled to permit continued eruptive tooth movement, which is achieved by the fibroblasts.

As the eruptive movements begin the enamel of the crown is still covered by a layer of ameloblasts and remnants of enamel organ together called as reduced enamel epithelium. The bone covering the erupting teeth is soon resorbed and the crown passes through the connective tissue of the mucosa, which is broken down in advance of erupting tooth. This reduced enamel epithelium and oral epithelium fuse and form a solid knot of epithelial cells over the crown of the tooth. The central cells of this mass of epithelium degenerate, forming an epithelial canal through which crown of the tooth erupts. During eruption the cells of the reduced enamel epithelium lose their nutritive supply and degenerate, thus exposing enamel.

When the erupting tooth appears in oral cavity, it is subjected to environmental factors that help determine its final position in the dental arch.

Theories of Mechanism of Tooth Eruption

Many theories have been proposed to explain the mechanism of eruption but it seems that eruption is a multifactorial process.

Possible mechanisms currently favored although they are not mutually exclusive, are:

- A. Papillary Constriction Theory

- B. Bony Remodelling
- C. Epithelial Path Theory
- D. Cushion Hammock Theory
- E. Root formation
- F. Hydrostatic pressure
- G. Selective deposition and resorption of bone around the tooth
- H. PDL – traction.

Papillary constriction theory: Dental papilla constricts because of decrease in the volume of the pulp cavity by continuous dentin formation and this generates a propulsive force.

Bony remodelling: Forces acting during eruption is similar to that seen in cranial bone sutures. The sutural connective tissue grows as a result of tension created by the growing brain. The bones thus move apart. The space thus created is transformed into bone keeping the sutural width more or less the same. Similarly the connective tissue of dental follicle and periodontal ligament proliferate and the tooth and crypt are pushed away from each other. The crypt cannot move, but the tooth moves away and this space is filled by growing root and bone apposition. Eruption is due to the differential growth between tooth and bone.

Epithelial Path Theory: Hair, nail and salivary gland are end product of the epithelial down growth. They return to the surface by the path, down which the original epithelium grew. Enamel is also an epithelial structure and so returns back to the surface.

Cushion Hammock theory: This theory states that root grows and pushes against the cushion Hammock ligament which passes from one side of the socket wall to the opposite. Recent works has shown that this Hammock ligament does not extend across the socket, but only separates the pulp from the follicle.

Root formation: According to this theory, as the root grows apically there is a force generated in an opposite direction that propels the tooth occlusally. This theory is not accepted as the force generated is not adequate to push the tooth into occlusion.

Hydrostatic pressure: It is known that teeth move in their socket in synchrony with the arterial pulse, and



this was said to be responsible for movement of tooth during eruption. But it is difficult to link such observations to eruptive tooth movements and does not have adequate experimental support.

Bone remodelling: The inherent growth pattern of the jaws moves the teeth by selective deposition and resorption of bone in the immediate neighborhood of tooth. But whether they are completely responsible for eruption of tooth is clearly not understood.

Periodontal ligament traction: If the normal architecture of the periodontal ligament is disturbed experimentally by interfering with collagen synthesis, eruptive tooth movement is either slowed or stopped. The contractility of fibroblasts in the periodontal ligament is said to exert comparatively large and sustained tractional forces that is useful to push the tooth in occlusal direction as occurs during eruption.

Post-eruptive Movements

- They are the movements made by the tooth after it has reached its functional position in the occlusal plane. Post-eruptive tooth movements helps in readjustment of the tooth in the socket. This is achieved by the formation of new bone at the alveolar crest and on the socket floor to keep pace with the increasing height of the jaws. Such movements can be in axial, mesial or distal directions.
- Axial movement is the movement in occlusal direction the tooth makes to compensate for occlusal wear.
- Mesial or proximal drift involves a combination of two separate forces resulting from occlusal contact of teeth and contraction of the trans-septal ligaments between them.

Clinical changes associated with tooth eruption (Figs. 5.5 to 5.9) is discussed in chapter 22.

Problems During Eruption of Teeth

Difficult Eruption/Teething

In most children the eruption of primary teeth is preceded by increased salivation and the child will want



Fig. 5.5: Pre-eruptive swelling seen on the ridge just before tooth eruption



Fig. 5.6: Tooth seen erupting through the gingiva



Fig. 5.7: Teeth in the process of eruption

to put the hand and fingers into the mouth. Some children become restless and fretful, exhibit increase in the amount of finger sucking or rubbing of the gum, drooling and loss of appetite during the time of eruption of the primary teeth. It is coincidentally associated with



Fig. 5.8: Fully erupted permanent incisors



Fig. 5.9: Note the pattern of physiologic root resorption of lower first and second deciduous molars seen during the eruption of the premolars

diarrhea, fever and even convulsions and is not directly attributed to eruption. All these features may be due to mouthing of contaminated toys or teethingers which the children use to rub the gums.

Local conditions observed during teeth eruption are gum inflammation, ulcer in mouth, cheek flush and cheek rash. Inflammation of the gingival tissues before complete emergence of the crown may cause a temporary painful condition that subsides within a few days.

Symptoms often associated with teething are

- irritability (most prevalent),
- restlessness,
- drooling,
- disturbed sleep,
- decreased food consumption,
- increased fluid intake,
- diarrhea,
- fever, and rash.

Management: Treatment for teething is symptomatic and palliative. If the child is having extreme difficulty, the application of a non-irritating topical anesthetic gel may bring temporary relief. The parent can apply the anesthetic gel to the affected tissue over the erupting tooth 3 or 4 times a day. The child can be given vegetables such as carrot that are hard and chewable to bite on to it. This may give some relief to the child. Commercially available sterile and clean teethingers can also be used. Reassuring the parents is helpful. Fever, if present, should be treated with acetaminophen. If the fever is persistent, the child should be referred to a pediatrician. Use of a chewable object and topical anesthetics will help relieve local irritation.

Eruption Hematoma/Eruption Cyst

It appears as bluish purple, elevated area of tissue, which develops a few weeks before the eruption of a primary or permanent tooth. This blood filled cyst is most frequently seen in primary second molar or permanent first molar region. Within a few days the tooth breaks through the tissue and the hematoma subsides. Since it is self correcting, treatment is usually unnecessary.

Eruption Sequestrum

Sequestrum is a tiny spicule of nonviable bone overlying the crown of an erupting permanent molar. They have little or no clinical significance, as they usually sequestrate spontaneously.

Natal and Neonatal Teeth

- Natal teeth are those that are present at birth and neonatal are those that erupt within the first 30 days of birth.
- About 85% of the natal or neonatal teeth are lower incisors. It can also be a predeciduous teeth.
- The cause is obscure, familial occurrence have been reported. Natal and neonatal teeth were seen in 3 generations of a single family and the hereditary transmission has been most characteristic of an autosomal dominant trait.
- The mandibular incisor region is the most prevalent location.



- The condition is probably attributed to superficial positioning during the formation of the involved tooth germ.
- Natal teeth may resemble normal primary teeth. In many instances, however, they are poorly developed, small, conical shaped, yellowish brown opaque, and have hypoplastic enamel and dentin, poor texture, and small root.
- Natal and neonatal teeth that lacks root structure, will usually exfoliate prematurely during infancy, presenting a potential hazard for aspiration.
- Natal and neonatal teeth are reportedly associated with 3 syndromes:
 - Chondroectodermal dysplasia or Ellis Van Creveld syndrome
 - Hallermann – Streiff Syndrome
 - Pachyonychia congenital syndrome
- Natal teeth appear more frequently than neonatal teeth in a ratio of 3:1.
- A sharp incisal edge of the natal or neonatal teeth may lacerate the tongue and cause difficulty while breastfeeding or endanger the infant with possible aspiration.
- In such cases it may be extracted or otherwise left without extraction. Where possible, extraction should be avoided until after the tenth postnatal day to avoid hemorrhage, due to possibility of Vitamin K deficiency present.
- *Riga-Fede disease*: Is characterized by the formation of an ulcer on the ventral surface of the tongue caused by the natal or neonatal teeth rubbing against the teeth. It is also called as Fede's disease or Riga-Fede syndrome.

Epstein Pears, Bohn's Nodules and Dental Lamina Cysts

They are inclusion cysts and are of 3 types:

- A. *Epstein pearls* – formed along the median palatine raphe. They are considered remnants of epithelial tissue trapped along the raphe as the fetus grows.
- B. *Bohn's nodules* - formed along the buccal and lingual aspects of the dental ridge and on the palate away from the raphe. They are considered remnants of

mucous gland tissue and histologically are different from Epstein pearls.

- C. *Dental lamina cysts* – they are found on the crest of maxillary and mandibular ridges. They originated from remnants of the dental lamina.

Ankylosis

It is the aberration of tooth eruption in which the continuity of the periodontal ligament has been compromised and the tooth is fused to the underlying bone.

The tooth appears submerged and does not occlude with the opposing tooth, as the ankylosed tooth is in the state of static retention whereas in the adjacent areas eruption and alveolar growth continues.

There are high chances for the occurrence of many ankylosed teeth when a patient is diagnosed to have one or two ankylosed tooth in oral cavity.

Mandibular primary molars are the teeth most often observed to be ankylosed. Ankylosis of anterior primary tooth usually follow any kind of trauma.

Diagnosis

Diagnosis of an ankylosed tooth can be made based on the following points:

- No contact with opposing molar
- Not mobile inspite of advanced root resorption
- Comparing the sound by tapping the involved and adjacent tooth. Ankylosed tooth exhibits solid sound, but a normal tooth has a cushioned sound
- Break in the continuity of periodontal membrane.

Management of ankylosed tooth:

- A. Surgical Removal, if the permanent successor is present
- B. If permanent teeth are missing, functional occlusion is established with stainless steel crowns on the affected tooth.

Understanding tooth development and eruption will guide a practitioner to diagnose or differentiate normal from an abnormal. Constant evaluation or observation of the development of teeth and occlusion can be included under preventive dentistry program thus intervening any developing malocclusion at its early stage.



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Chapter 6



Development of Occlusion

1. Introduction
2. Pre-Dental / Dentate Period
 - The gum pads
3. Deciduous Dentition Period
 - Eruption age and sequence of deciduous dentition
 - Features of deciduous dentition period
4. The Mixed Dentition Period
 - First transitional period
 - Inter transitional period
 - Second transitional period
5. The Permanent Dentition Period
6. Self Correcting Anomalies/ Transient Malocclusion and their Correction



INTRODUCTION

At birth the alveolar ridges are plain firm tissue with no teeth on them. As the child grows steady changes are seen both on and within the ridge. The alveolar ridge grow and enlarge while the teeth develop to attain their final shape and size within the jaws. As per the predetermined time individual teeth erupt and align and come into a full fledged occlusion with each other.

The study of this development of occlusion can be divided into the following developmental periods (Fig. 6.1):

1. *Pre-dental/dentate period*: This is the period after birth during which the neonate does not have any teeth. It usually lasts for 6 months after birth. The characteristic feature is the alveolar ridge that are called as gumpads.
2. *The deciduous dentition period*: The initiation of primary tooth buds occurs during the first six weeks of intrauterine life. The primary teeth begin to erupt at the age of about 6 months. The eruption of all

primary teeth is completed by 2- 2 ½ years of age when the second deciduous molars come into occlusion.

3. *The mixed dentition period*: The mixed dentition period begins at approximately 6 years of age with the eruption of the first permanent molars. During the mixed dentition period, the deciduous teeth along with some permanent teeth are present in the oral cavity.
4. *The permanent dentition period*: This period is characterized by the presence of all permanent teeth.

PRE-DENTAL/DENTATE PERIOD

The Gum Pads

Features of Gum Pads (Figs 6.2A to 6.3)

- The alveolar processes at the time of birth are known as gum pads. The gum pads are pink, firm and are covered by a dense layer of fibrous periosteum.
- They are horse-shoe shaped and develop in two parts, the labiobuccal portion and the lingual portion.

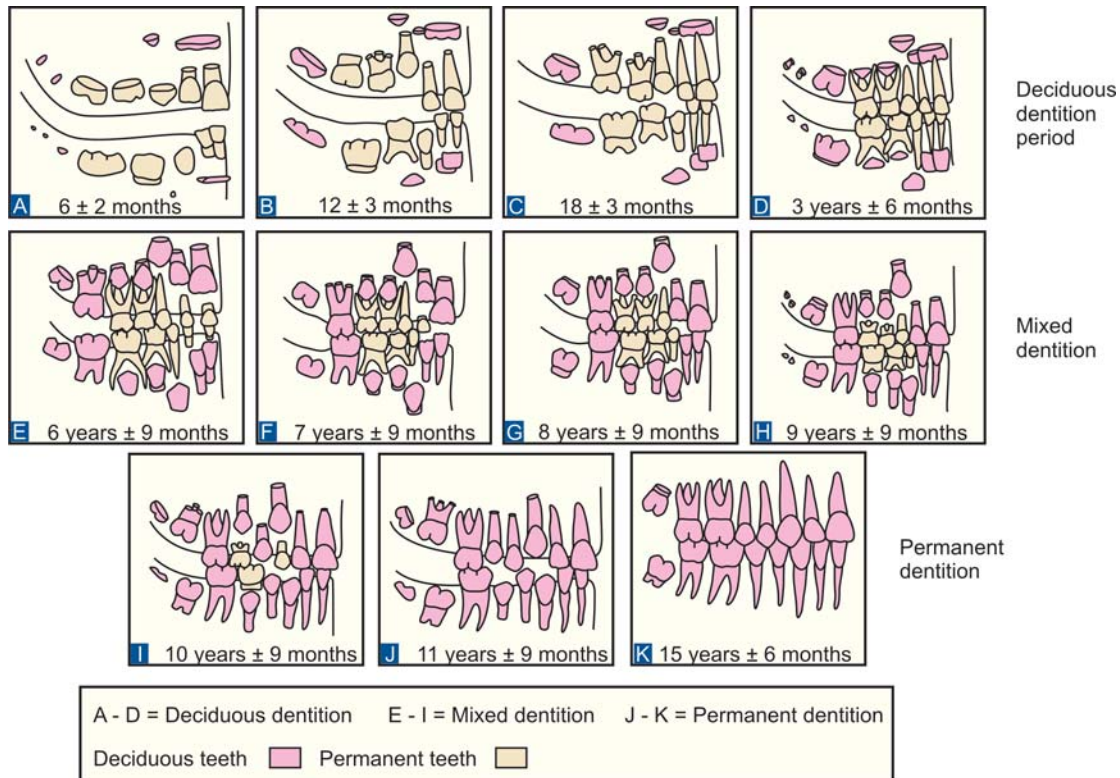
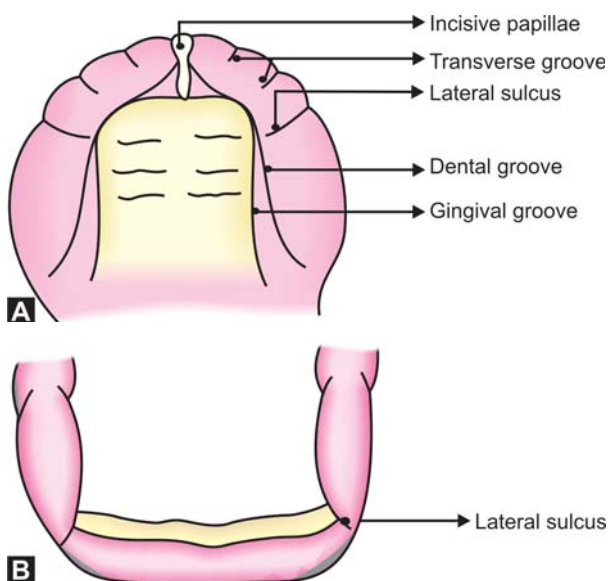


Fig. 6.1: Various developmental stages of teeth



The labiobuccal portion develops before the lingual portion. The two portions of the gum pads are separated from each other by a groove called the *dental groove*.

- The gum pads are divided into ten segments by ten grooves called *transverse grooves*. Each of these segments consists of one developing deciduous tooth sac.
- The transverse groove between the canine and first deciduous molar segment is called the *lateral sulcus*. The lateral sulci are useful in judging the inter-arch relationship at a very early stage. The lateral sulcus of the mandibular arch is normally more distal to that of the maxillary arch.
- The *gingival groove* separates the gum pad from the palate and floor of the mouth in upper and lower arch separately.
- The upper and lower gum pads are almost similar to each other. The upper gum pad is both wider as well as longer than the mandibular gum pad. Thus when the upper and lower gum pads are approximated, there is a complete overjet all around. This space is occupied by the tongue resulting in tongue thrust (infantile tongue thrust). Contact occurs between the upper and lower gum pads in the first molar region (Fig. 6.4). The upper lateral sulcus is positioned much anteriorly to the lower lateral sulcus.



Figs 6.2A and B: A. Upper gum pad; B. Lower gum pad



Fig. 6.3: Upper gum pad in a newborn child

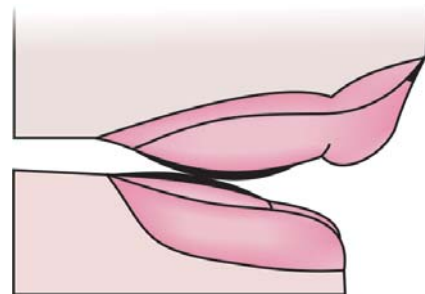


Fig. 6.4: Gum pads in occlusion

DECIDUOUS DENTITION PERIOD

Eruption Age and Sequence of Deciduous Dentition

The mandibular central incisors are the first teeth to erupt into the oral cavity. They erupt at around 6-7 months of age. A variation of 3 months from the mean age has been accepted as normal.

The sequence of eruption of the deciduous dentition is:

Central Incisor – Lateral Incisor – First Molar – Canine-Second Molar.

The primary dentition is usually established by 2½ years of age following the eruption of the second deciduous molars. Between 3 and 6 years of age, the dental arch is relatively stable and very few changes occur.

Features of Deciduous Dentition Period

1. Spacing in deciduous dentition
2. Terminal plane relation of the deciduous molars



3. Deep bite
4. The dental arches are wide U shaped
5. Flat curve of Spee
6. Shallow cuspal interdigitation
7. Incisors are more vertically placed

Spacing in Deciduous Dentition (Fig. 6.5)

Spacing normally exists between the deciduous teeth. These spaces are called physiological spaces or developmental spaces. The presence of spaces in the primary dentition is important for the normal development of the permanent dentition and absence of spaces in the primary dentition is an indication that crowding of teeth may occur when the larger permanent teeth erupt.

Spacing seen mesial to the maxillary canines and distal to the mandibular canines are wider than in other areas. These physiological spaces are called *Primate spaces* or *Simian spaces* or *Anthropoid spaces* as they are seen commonly in primates (Figs 6.6A and B). These spaces help in placement of the canine cusps of the opposing arch.

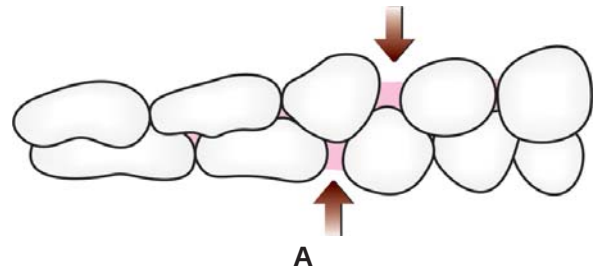
Terminal Plane Relation of the Deciduous Molars (Figs 6.7A to C)

The mesio-distal relation between the distal surfaces of the upper and lower second deciduous molars is called the terminal plane. They can be of 3 types as given by Baume:

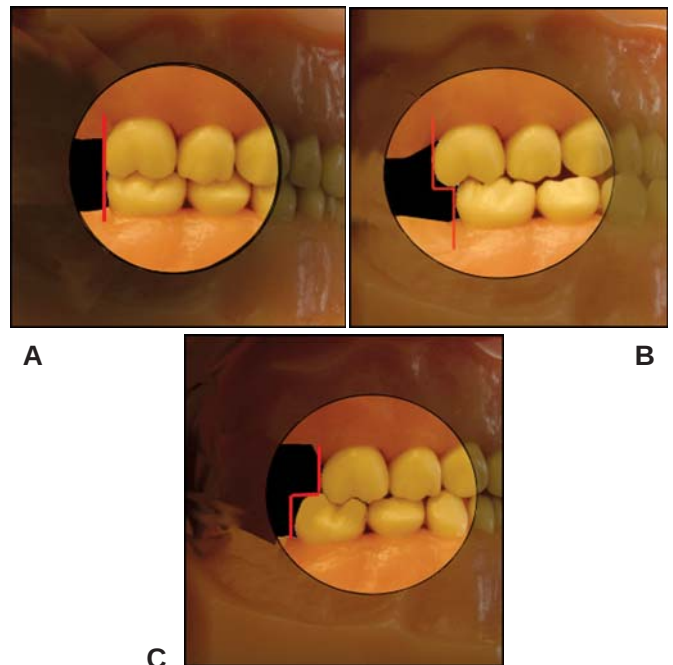
1. Flush terminal plane
2. Mesial step terminal plane
3. Distal step terminal plane



Fig. 6.5: Generalized spacing seen in deciduous dentition



Figs 6.6A and B: Primate space A: Diagrammatic representation of the primate space; B: Primate space in a 2-year-old child seen between deciduous upper lateral incisor and canine



Figs 6.7A to C: Terminal plane relation of deciduous molars; (A) Flush terminal plane (37%); (B) Mesial step terminal plane (49%); (C) Distal step terminal plane (14%)



Flush Terminal Plane

A normal feature of deciduous dentition is a flush terminal plane where the distal surfaces of the upper and lower second deciduous molars are in the same vertical plane.

Mesial Step Terminal Plane

In this type of relationship the distal surface of the lower second deciduous molar is more mesial to the distal surface of the upper second deciduous molar.

Distal Step Terminal Plane

In this type of relationship the distal surface of the lower second deciduous molar is more distal to the distal surface of the upper second deciduous molar.

Deep Bite (Fig. 6.8)

A deep bite may occur in the initial stages of development. The deep bite is accentuated by the fact that the deciduous incisors are more upright than their successors. The lower incisal edges often contact the cingulum area of the maxillary incisors. This deep bite is later reduced due to the following factors.

- A. Eruption of permanent posterior teeth.
- B. Attrition of incisors.
- C. Forward and downward movement of the mandible due to growth.

THE MIXED DENTITION PERIOD

The mixed dentition period can be divided into three phases.

1. First transitional period



Fig. 6.8: Deep bite seen in deciduous dentition

2. Inter transitional period
3. Second transitional period

First Transitional Period

The first transitional period is characterized by the emergence of the first permanent molars and the exchange of the deciduous incisors with the permanent incisors.

Eruption and Attainment of Occlusion of the First Permanent Molars (Figs 6.9A to C)

The mandibular first molar is the first permanent tooth to erupt at around 6 years of age. The location and relationship of the first permanent molar depends much upon the distal surface relationship between the upper and lower second deciduous molars. The first permanent molars are guided into the dental arch by the distal surface of the second deciduous molars. The deciduous molar relation determines the permanent molar relation as the later erupts into occlusion.

The shift in lower molar from the initial relation to final occlusion can occur in two ways. They are designated as the early and the late mesial shift. The forward movement of the first permanent molar utilizing the primate space is termed as *early mesial shift*. When the deciduous second molars exfoliate the permanent first molars drift mesially utilizing the Leeway space. This occurs in the late mixed dentition period and is called *late mesial shift*.

Occlusion of first permanent molar when deciduous molars are in flush terminal plane relation

The erupting first permanent molars may also be in a flush or end on relationship. For the transition of such an end on molar relation to a Class I molar relation, the lower molar has to move forward by about 3 - 5 mm relative to the upper molar. This occurs by utilization of the primate space and by differential forward growth of the mandible.

Early shift occurs during the early mixed dentition period. The eruptive force of the first permanent molar is sufficient to push the deciduous first and the second molars forward in the arch to erupt in Class I molar relationship.

Many children lack the primate space and in this situation the erupting permanent molars are unable to



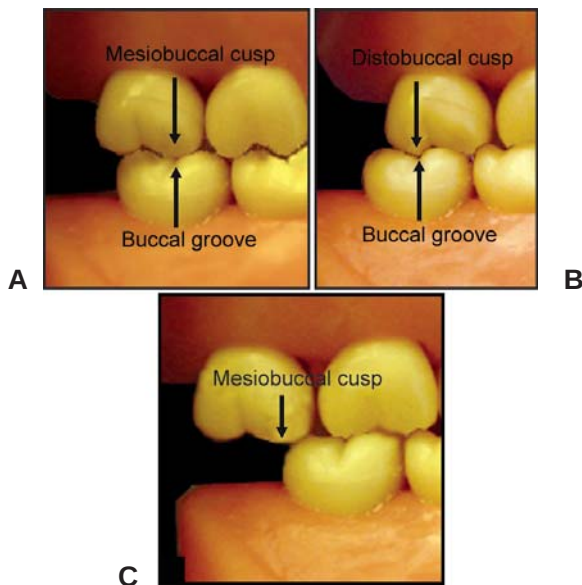
move forward to establish Class I relationship. In these cases, when the deciduous second molars exfoliate, the permanent first molars drift mesially utilizing the Leeway space. This occurs in the late mixed dentition period and is called late mesial shift.

Occlusion of first permanent molar when deciduous molars are in mesial step terminal plane relation

In this type of relationship the distal surface of the lower second deciduous molar is more mesial than that of the upper. Thus the permanent molars erupt directly into Angle's Class I occlusion. This type of mesial step terminal plane most commonly occurs due to early forward growth of the mandible. If the differential growth of the mandible in a forward direction persist, it can lead to an Angle's Class III molar relation. If the forward mandibular growth is minimal, it can establish a Class I molar relationship.

Occlusion of first permanent molar when deciduous molars are in distal step terminal plane relation:

This is characterized by the distal surface of the lower second deciduous molar being more distal to that of the upper. Thus the erupting permanent molars may be in Angle's Class II occlusion. Later the relation may shift to Class I if the forward mandibular growth is extensive.



Figs 6.9A to C: Occlusion of first permanent molar; A. Class I relation, B. Class II relation, C. Class III relation

The Exchange of Incisors

During the first transitional period the deciduous incisors are replaced by the permanent incisors. The mandibular central incisors are usually the first to erupt. The permanent incisors are considerably larger than the deciduous teeth they replace. This difference between the amount of space needed for the accommodation of the incisors and the amount of space available for this is called *Incisal liability*. The incisal liability is roughly about 7mm in the maxillary arch and about 5 mm in the mandibular arch.

Incisal Liability

The incisal liability is overcome by the following factors.

Utilization of physiologic spaces seen in primary dentition:

The physiologic or the developmental spaces that exist in the primary dentition are utilized to partly account for the incisal liability. The permanent incisors are much more easily accommodated in normal alignment in cases exhibiting adequate inter-dental spaces than in an arch that has no space.

Increase in inter-canine width: An increase in inter-canine width of both the maxillary as well as the mandibular arches allows the much larger permanent incisors to be accommodated in the arch previously occupied by the deciduous incisors.

Change in incisor inclination: One of the differences between deciduous and permanent incisors is their inclination. The primary incisors are more upright than the permanent incisors. Since the permanent incisors erupt more labially inclined they tend to increase the dental arch perimeter. This is another factor that helps in accommodating the larger permanent incisors.

Inter Transitional Period

This is a relatively quite phase and no active tooth eruption is seen.

In this period the maxillary and mandibular arches consist of deciduous and permanent teeth. Between the permanent incisors and the first permanent molars are the deciduous molars and canines. This phase during



the mixed dentition period is relatively stable and no change occurs.

Second Transitional Period

The second transitional period is characterized by the replacement and alignment of the deciduous molars and canines by the premolars and permanent cuspids respectively.

The features of second transitional period are:

1. Leeway space of Nance
2. Ugly duckling stage

Leeway Space of Nance (Fig. 6.10)

The combined mesiodistal width of the permanent canines and premolars is usually less than that of the deciduous canines and molars. The surplus space is called Leeway space of Nance. The amount of Leeway space is greater in the mandibular arch than in the maxillary arch. It is about 1.8 mm (0.9 mm on each side of the arch) in the maxillary arch and about 3.4 mm (1.7 mm on each side of the arch) in the mandibular arch. This excess space available after the exchange of the deciduous molars and canines is utilized for mesial drift of the mandibular molars to establish Class I molar relation.

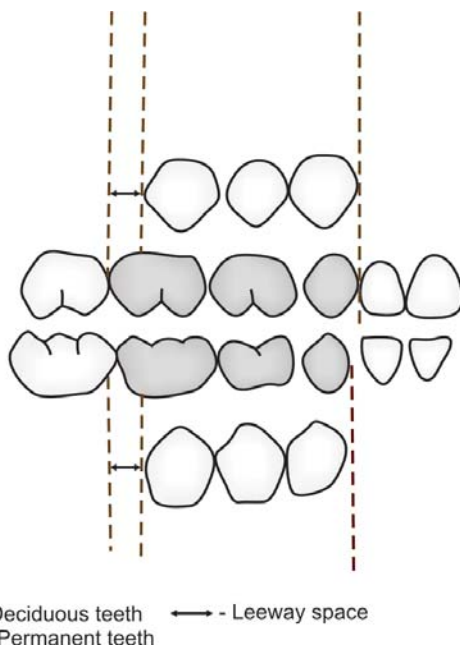


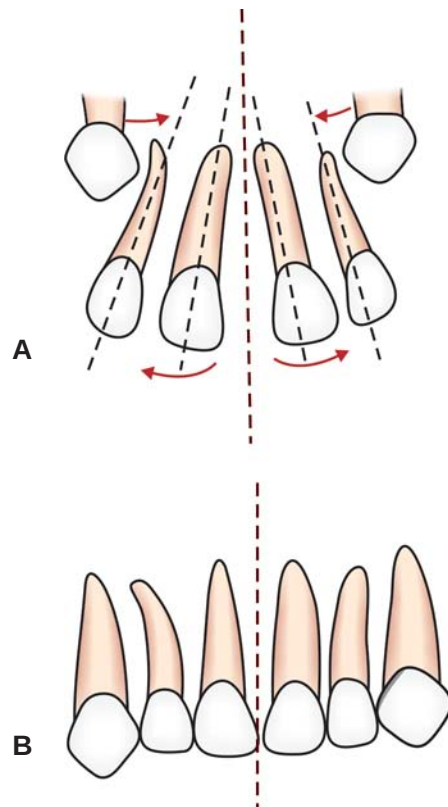
Fig. 6.10: Leeway space of Nance

The Ugly Duckling Stage

(Broadbent Phenomenon) (Figs 6.11A and B)

It is a transient or self correcting malocclusion seen in the maxillary incisor region between 8 and 9 years of age, seen during the eruption of the permanent canines. As the developing permanent canines erupt, they displace the roots of the lateral incisors mesially. This results in transmitting of the force on to the roots of the central incisors which also get displaced mesially. A resultant distal divergence of the crowns of the incisors occur leading to creation of diastema in the incisor region.

Broadbent named this as the ugly duckling stage as children tend to look ugly during this phase of development. Parents are often apprehensive during this stage and consult the dentist. This condition usually corrects by itself when canines erupt as the pressure is transferred from the roots to the crown of the incisors.



Figs 6.11A and B: Broadbent phenomenon



THE PERMANENT DENTITION PERIOD

The permanent dentition is complete with the eruption and alignment of the maxillary canines which is the last tooth to erupt into the oral cavity excepting the third molars.

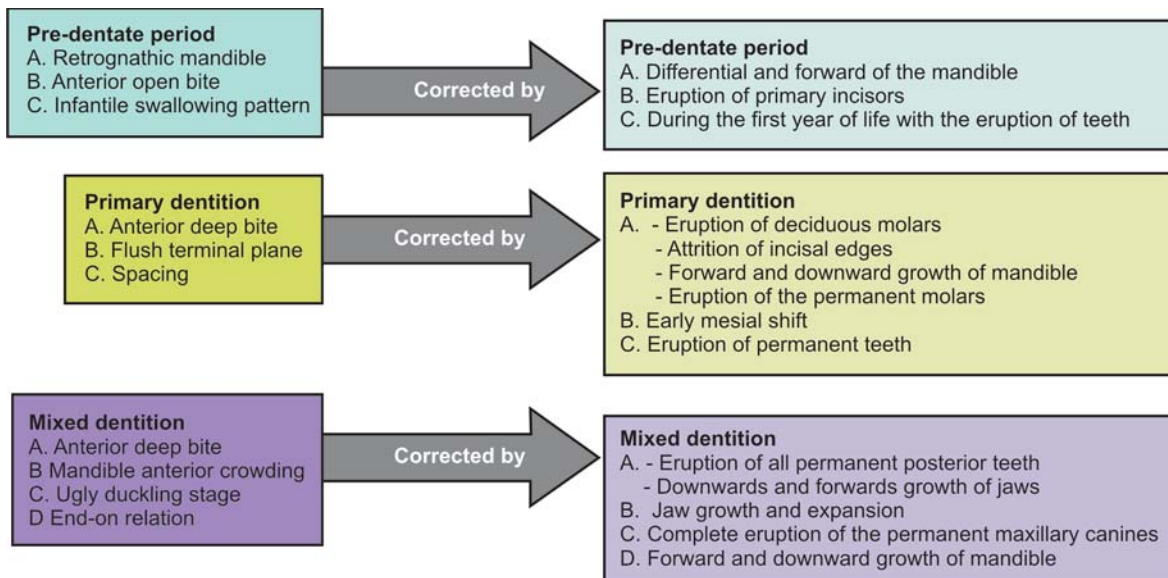
The permanent molar relation is classified into 3 types, as given by Angle:

Angle's Class I: The mesiobuccal cusp of the maxillary first permanent molar occludes with the buccal groove of the mandibular first permanent molar.

Angle's Class II: The distobuccal cusp of the maxillary first permanent molar occludes with the buccal groove of the mandibular first permanent molar.

Angle's Class III: The mesiobuccal cusp of the maxillary first permanent molar occludes in between the lower first and the second permanent molars.

Self Correcting Anomalies/ Transient Malocclusion and their Correction



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Chapter 7



Psychological Development

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INTRODUCTION

Psychology is a combination of scientific analysis and clinical application of behavior. Behavior of each individual varies depending on the age, mood and environment. Behavior is the action of what the person thinks, understands, analyses and pursues. It is an observation that can be seen, recorded and studied. Understanding psychology will help dentist to detect any deviations in normal behavior that might interfere with treatment process. Psychology thus comprises of systematized knowledge that is gathered through carefully measuring and observing events and summarized to form theories.

Psychology can be defined as “the science dealing with human nature and behavior. It also includes understanding of the pattern of mental processes characteristic of an individual”.

The term development is used to describe a series of changes that is progressive occurring as a result of maturation and experience, and implies qualitative change. This progressive maturation helps a person to adapt to the environment.

Psychologic growth and development generally proceed in a relatively predictable, logical and sequential order. An understanding of the developmental tasks and behaviors common to specific age groups will equip the dentist with the knowledge of the particular needs or fears of children and adolescents. It will also enable the dentist to detect deviations in these patterns which may interfere with the treatment process.

In the initial years the investigators of developmental psychology sought to learn the typical age at which various stages of development occurred. For the most part, research studies were concentrated on preschool and school-age children and on adolescents. Only later did research extend downward, first to birth and then to conception, and later upward, to adulthood, old age, and finally to middle age.

Initial understanding of behavior began with the classical Greek philosophers and became a separate entity a little over 100 years ago. The first psychological laboratory was established at the University of Leipzig by German philosopher-psychologist Wilhelm Wundt.

The first formal psychology laboratory in the United States was set up by Johns Hopkins University in 1883. It was William James who through his book ‘The Principles of Psychology’ introduced psychology as a separate field.

John Bowlby stated (Attachment theory) that the interaction between a child and its caregiver is very important during the systematic progression from childhood to adulthood. Problems in this relation would lead to an child who is insecure and finds it difficult to adjust and develop relationships.

THEORIES OF PSYCHOLOGICAL DEVELOPMENT

The theories of psychological development can be studied under two groups, the psychodynamic and behavior learning theories.

Psychodynamic Theories

1. Psychoanalytical theory by Sigmund Freud, 1905
2. Hierarchy of needs by Abraham Maslow, 1954
3. Psychosocial theory by Erik Erikson, 1963

Psychoanalytical Theory (Sigmund Freud, 1905)

Freud’s theory of development has 2 primary ideas: One, everything you become is determined by your first few years. The adult behavior is exclusively determined by the child’s experiences, because whatever actions occur in adulthood are based on a blueprint laid down in the earliest years of life. Two, the story of development is the story of how to handle anti-social impulses in socially acceptable ways.

Libido was Freud’s word for psychic and sexual energy. How Libido is expressed depends on the stage of development. But in each stage of development there are frustrations. If those frustrations are not successfully dealt with, then the libido will be tied to that stage of development more than it should and then there will be less for the other stages. Such overuses will be reflected in later behavior in one of two ways.



Freud has explained behavior based on 3 components (Psychic Triad). They are:

- a. Id
- b. Ego
- c. Superego

Id: The id is governed by the pleasure principle, which suggests that all processes operate to achieve the maximum amount of pleasure. It represents unregulated instinctual drives and energies striving to meet bodily needs and desires and is present since birth. It is governed by pleasure principle. Examples are hunger, thirst, sexual drive, aggression, etc. These drives are necessary for the survival of the species. The id wants its wishes immediately and directly fulfilled. Ego and superego usually temper id.

Ego: The ego is the mediator between the id and the superego. It is a part of self conserve, concerned with the overall functioning and organization of the personality. It involves functions such as memory, language, intelligence and creativity. Ego is concerned with maintaining a state in which adequate expression of id can occur within the constraints of reality and demands and restrictions of superego. Thus ego tries to bring together the wishes of the id, and the moral attitudes of the superego. The ego can and might postpone the requirements or needs of id keeping in mind the reality and deciding on what may be the best course of action to attain goals of the id and superego.

Superego: It is similar to social conscience. It is derived from familial and cultural restrictions placed upon the growing child. The superego thus contains all of the moral lessons the person has learned in their life, initially from parents and later from friends and others. Superego formation continues during school age and is present through the entire life. It is based on identification with important figures such as teachers, sports hero, etc. If ego is stronger and superimposes upon superego, restrictions set by superego would be weak and ineffective, leading to the possibility of unsocialized behavior.

Unresolved conflicts between the id-ego and superego-ego can lead to a fixation or blockage in development.

Example: If a person sees the food displayed on the shelf of a bakery and wants to take it from the shelf and eat it to satisfy his hunger. This is id. Superego stops him from doing this, because it is not socially and culturally right to take the food from the shelf of the bakery. Now to satisfy id under the norms of superego, ego convinces him to go to the counter, pay the money and take the desired food.

Phases of Development, Based on Id, Ego and Superego

Oral stage: 0 - 1 year: This occurs from birth to about 1 year, and the libido is focussed on the mouth. The primary zone of pleasure is the oral region and infants obtain gratification by stimulation of oral areas. Develops trust when his basic needs are fulfilled.

Result of oral stage disturbance: According to Freud, disturbance of the oral stage may result in a permanent fixation on the oral channel for gratification. It may result in adult behaviors pertaining to oral cavity such as smoking, overeating, thumb-sucking, and pencil chewing. Typical resulting personality traits include impatience, passivity, greediness, dependence and a preoccupation with giving and taking.

Anal stage: 1-3 years: The child experiences pleasure from the elimination of faeces. According to Freud, this brings them into conflict with their parents. Random elimination (as demanded by the id) incurs parental displeasure. Withholding elimination (as requested by the parents) is denying the demands of the id. This results in conflict and may have important implications for behaviors later in life. Here individuals have their first encounter with rules and regulations, as they learn toilet training. This encounter with rules and regulations will dictate the later behavior with rules and regulations. When done successfully it provides a sense of independence and autonomy.

Result of anal stage disturbance: According to Freud, it may be caused by either exceptionally strict toilet training or intense pleasure associated with taboos such as smearing faeces on the wall. Too little gratification in this stage results in an 'anal' or obsessive character



who has a wish to make a terrible mess and therefore must build defences against this, such as orderliness, rigidity, and hatred of waste. They are also obstinate, stingy, punctual and possessive. Too much gratification will result in opposite behaviours like untidiness, hot temper and destructiveness.

Phallic stage: 3-6 years: The focus of gratification in this stage is on the genitals. Children take an increasing interest in their own genitals, and show a curiosity about other people's bodies. Freud implies that the major conflict faced during this stage is the Oedipal/Electra conflict. Resolution of this conflict should result in the attachment to the parents.

Result of phallic stage disturbance: According to Freud, the conflicts may result in homosexuality, authority problems, and rejection of appropriate gender roles if not resolved.

Latency stage: 7-12 years: This lasts from about the age of 7 until puberty, and this is a period of rest where there are no developmental events. Libido submerges and child becomes unisexual. Personality identification begins and tries to socialize. Repressed sexual drives during this stage may be redirected into other activities, such as the formation of friendships, or hobbies.

Genital stage : >12 years: Adult sex emerges and begins with puberty and libido begins to be used in its sexual role.

Result of genital stage disturbance: The individual cannot reach maturity, cannot shift the focus from their own body, their own parents and their immediate needs to larger responsibilities involving others.

Oedepus Complex:

It is the tendency of young boy child being attached more to the mother than the father

Electra Complex:

It is the tendency of the young girl child developing an attraction towards father

Hierarchy of Needs (Abraham Maslow,1954)

He identified a hierarchy of basic human needs that motivate individual behavior. Only when these basic

needs are met an individuals can achieve their full potential and attain self-respect, self-fulfillment, self-worth, self-determination.

The basic needs were classified based on hierarchy as

Level 1: Physiologic needs (needed for survival such as hunger, thirst, reproduction, etc)

Level 2: Security (need for shelter and employment)

Level 3: Social (need to be loved and have a sense of belonging)

Level 4: Esteem (competency and skill needs. To feel wanted)

Level 5: Self- actualization (realization of self)

Lower levels of needs have to be fulfilled for the functioning of higher level of needs.

Psychosocial Theory (Erik Erikson, 1963)

Erik Erikson has modified Freud's theory and postulates that society responds to the child's basic needs or developmental tasks. He combines both internal psychological factors and external social factors to explain.

He has described the development into 8 stages. The first five are during childhood and adolescence. Each stage builds upon the others and focuses on a challenge (or crisis) that must be resolved during that stage in order to move effectively onto the next stage of development. Unresolved conflicts from earlier stages may continue to affect later development.

I stage: 1st year of life

- Trust vs mistrust.
- Basic needs are met by the person whom he trusts. When these are not met he develops mistrust. Child with a sense of trust may have the sense of mistrust activated at a later stage such as parents getting divorced.
- Hope and danger present. Example –child with a sense of mistrust may come to trust a particular person like a teacher who has taken the trouble to be trust worthy developing hope.

II stage: 2-3 years

- Autonomy vs doubt.



- Child at this age wants to do certain things to himself such as pulling the wrapper off the candy, flushing the toilet, etc. If parents recognize this, the sense of self control is developed.
- Failure leads to doubt or shame.
- The child who is autonomous out balances the feelings of shame and doubt and is well prepared to be autonomous at his later phases of life.
- Principal anxiety during this period is loss of love and fear of separation.

III stage: 4-5 years

- Initiative vs guilt.
- The child at this stage wants to take part in many activities, ask more questions etc.
- Children who are given more freedom in taking part in social activities will have their sense of initiative reinforced. Initiative is also reinforced when parents answer their children's questions.
- On the other hand if the child is made to feel that a certain activity is bad, that the questions are a nuisance and that play is silly and stupid then the child may develop a sense of guilt over self initiated games or questions and will persist through later years.
- Primary fear is of bodily injury.

IV stage: 6-11 years

- Industry vs inferiority.
- Child becomes capable of deductive reasoning and of playing 'take turn' games that require obedience to rules.
- Child becomes industrious and when allowed to finish the efforts they are rewarded for the results and a sense of industry is enhanced. Failure leads to sense of inferiority.

V stage: 12-18 years

- Identity vs role confusion
- Period of adolescence
- Mental and physiological maturation is present
- Impatient, idealist, who believes that it is as easy to realize a ideal as it is to imagine it.
- Importance of parents is more indirect.

Behavior Learning Theories

Learning is a permanent change in behavior that occurs as result of practice or experience. Understanding learning pattern will help during behavior management

process. Some of the principles used in understanding behavior learning are:

1. Classic conditioning by Ivan Pavlov, 1927
2. Operant conditioning theory by B.F. Skinner, 1938
3. Cognitive theory by Jean Piaget, 1952
4. Social learning theory by Albert Bandura, 1963

Classic Conditioning (Ivan Pavlov, 1927)

This theory is the result of the classic experiments of Ivan Petrovich Pavlov. It is also called as 'respondent conditioning' or 'Pavlovian conditioning'.

Pavlov had designed an apparatus that could measure how much a dog's mouth waters in response to food or other things in its environment. He trained the dog by sounding the bell and shortly afterward presented food. After few sessions the dog would salivate at the sound of the bell. This is the conditioned response what the dog has learned. The acquisition of conditioned response is usually gradual and requires more trials but once acquired is more strong.

'Stimulus Generalization' is another term that should be remembered. Pavlov noticed that the dog began salivating when the bell was replaced by a buzzer or similar sound producing machine. Generalization means that conditioned responses occur to stimuli that have never been paired with a specific stimulus. Development of phobia in children to a specific environment or action may be due to stimulus generalization most of the time. Understanding this is important because the original cause for the fear must be dealt with before applying any behavior management procedure. Since some emotional responses to stimuli are learned they can also be unlearned. The extinction and alteration of disturbing emotional responses by classical conditioning is one form of behavior shaping or is called as behavior modification.

Operant Conditioning Theory (BF Skinner, 1938), also called as Instrumental Conditioning

The key feature of this form of learning is that some action or behavior of the learner is instrumental in bringing about a change in the environment that makes the action more or less likely to occur again in the future. An individual learns to produce a voluntary response



where the outcome results in bringing about the reoccurrence of the stimulus. The response to a stimulus which produces a satisfactory outcome will be repeated whereas those which met disagreeable results will tend to diminish. This theory thus explains development or continuation of new behavior as a result of reinforcement.

Some of the terms identified with operant conditioning and are commonly used methods of influencing an individual response are:

Reinforcement: It can be positive (occurs when a positive stimulus is introduced/given after the desired response is achieved) or negative (occurs when a negative stimulus is removed after the desired response is achieved).

Positive reinforcement is a stimulus or event which, when it follows a response, increases the likelihood that the response will be made again. These reinforcers serve as contingent on some behavior. A well known example is giving a biscuit to a dog after it has performed some desired tricks.

Negative reinforcement is another tool which, when its cessation or termination is contingent on a response, increases the likelihood that the response will occur again.

Reward: the result of adding positive outcomes and/or removing negative ones.

Punishment: It is another technique that is used in instrumental conditioning. Punishment is the onset of the event that is contingent on the response, whereas negative reinforcement is the ending of the event that is contingent on the response.

Omission: The forth technique is the use of omission of reinforcement or omission training. In this, positive reinforcement is withdrawn following a response. The effect is to decrease the likelihood of the response that led to the removal of the positive reinforcement. Example of omission is, when watching television which is actually a positive reinforcer is withdrawn as the child exhibited an unwanted behavior.

Cognitive Theory (Jean Piaget, 1952)

Jean Piaget emphasizes that childhood development proceeds from an egocentric position through a predictable, step like consistent expansion by incorporation of learned experiences. This theory tries to explain the development based on the influence of behavior on thought processes.

Periods of cognitive growth is grouped into 4 major periods. Development into the next stage is possible if previous stages have been mastered.

1. Sensorimotor period
2. Pre-operational period
3. Period of concrete operations
4. Period of formal operations.

Sensorimotor period: birth to 18 months

- In this period, intelligence is demonstrated through motor activity.
- Knowledge of the world is limited.
- Children acquire memory or object permanence at about 7 months of age. Physical development leading to mobility helps the child to develop new intellectual abilities.
- He learns to integrate the sensory modalities and becomes able to look towards the object and make a sound or reach and hold the object he desires.
- Piaget describes this behavior as genuinely adaptive and intelligent at a behavioral level but not totally concrete and not accompanied by cognitive awareness of the causality or outcome of action.

Pre-operational period: 18 months - 7 years

- It is a transitional period from the sensorimotor period to the concrete operations, where the concepts of time, space, number and logical ordering are acquired.
- In this period, intelligence is demonstrated through the use of symbols. Language improves.
- Memory and imagination are developing, but thinking is done in a nonlogical, nonreversible manner. During this period marked inconsistencies appear in the child's thinking. The child often acknowledges understanding something with true



sincerity, only to be betrayed by completely opposite actions shortly thereafter.

Period of concrete operations: 7-12 years

- During this period intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects and the child undergoes enormous surge in intellectual development guided by academic rigor.
- He develops the ability to classify objects according to the attributes of size, shape, color and consistency. He can compare and classify.

Period of formal operations: 12-18 years

- In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts and hypothetical reasoning.
- There is advance in cognitive development and is directly related to experience in school.
- The major shift is the ability to utilize abstract thinking, logical operations.
- Individual who never proceed beyond elementary school do not develop this capacity for formal operations and are thus limited in occupations requiring abstract logical thinking.

Social Learning Theory (Albert Bandura, 1963)

The principle of this theory is based on the basic fact that behavior is learned through observation of consequences. He believes that people acquire behaviors through the observation of others. The people then imitate what they have observed. He has done several studies involving television commercials and videos containing violent scenes that support this theory of modeling.

From early infancy the child strives to have his basic needs met in order to reduce tension and to create a satisfied pleasure feeling. The infant quickly learns in a reflexive manner that certain behaviors on his part elicit responses from his parents. If these responses are pleasing and rewarding to the child, the initial behavior will be repeated over and over and will eventually become part of his behavior and personality. This approval or disapproval of the mother acts as a powerful reinforcer of certain behavior in the child and permits the mother to shape and modify the child's behavior toward socially acceptable behavior.

VALUES OF KNOWING THAT CHILDREN DEVELOP DIFFERENTLY

Different Expectations

All children of the same age cannot be expected to behave in the same way. A child who comes from a culturally deprived environment cannot be expected to learn or read as early as a child whose parents put high value on education and encourage the child to be interested in reading.

Basis of Individuality

The child, who is different from members of the group, provided the difference is not so great so as to be conspicuous, will be interesting to other children and will be able to contribute something different to the group activities.

Child Rearing must be Individualized

One child may respond favorably to authoritarian control because it gives a feeling of security while another child will respond with antagonism and resentment.

Prediction is Difficult

Even when it is known how the average person reacts in a given situation, it is never possible to predict how a specific person will react. One person for example may find a joke 'hilariously funny', while another person may find it 'boring and stupid'.

MAJOR DEVELOPMENTAL PERIODS IN THE DEVELOPMENT OF A CHILD TO A FULL MATURED ADULT

Prenatal Period (Conception to Birth)

It is strongly agreed that the development of psychology does not begin only after birth, but is also influenced deeply by the conditions before birth. This period is very important for some of the following reasons:

- The hereditary characteristics that form the foundation for the later development is formed at this stage.



- Unfavorable conditions during development may stunt the development potential to the extent of extreme deviation.
- Proportionally greater growth and development occurs during this stage than at any postnatal period.
- This period is very sensitive to physical and chemical hazards.

Infancy (Birth to 10-14 days)

This is the period of the newborn or the neonate. During this time, the infant must adjust to a totally new environment outside the mother's body. Growth is temporarily at a standstill.

Conditions Influencing Adjustment to Postnatal Life

- *Prenatal development:* Prenatal environment plays a major role in the development of the fetus.
- *Experiences associated with birth:* Difficulty during birth may have adverse effect on the postnatal adjustments.
- *Length of gestation period:* A post mature infant adjusts more quickly and successfully to the postnatal environment than the infant born at full term. Similarly a prematurely born babies usually experience complications in adjusting to the postnatal environment.
- *Parental attitudes:* Positive parental attitude will help the newborn adjust quickly to postnatal environment.
- *Postnatal care:* The amount of stimulation, attention and the degree of confidence the infant will receive influences the postnatal adjustment to life.

Characteristics of an Infant

- *Activities:* These can be divided into mass activity and specific activity. Mass activity indicated involvement of the entire body whereas specific activity involving limited area such as reflex response to touch. These activities gradually increase. Long labor or heavily sedated mother during child birth may cause the infant to be relatively inactive for few

days following birth. Infants delivered by cesarean section are the least active of all.

- *Vocalization:* Two kinds of sounds a child produces, one is crying and the other is explosive sounds. Crying begins at birth. Shortly after birth the cry changes in pitch and intensity. The explosive sounds are in simpler terms called as 'coos' or 'gurgles'.
- *Learning:* Conditioned reflex in infants are not development exception being regarding feeding.
- *Emotions:* The emotions in a child is concentrated around being satisfied or not with relation to hunger, temperature or feeling secure. They are very sensitive to parental depression and lack of stimulation
- *Vision:* Newly born have a shorter field of vision to about one half that of an adult. Color vision is either absent or minimal.
- *Hearing:* It is the least developed senses at birth. Hearing improves within the first three or four days of birth.
- *Taste perception:* Infants have a keen sense of taste.
- *Skin sensitivity:* Sensitivity to touch, pressure and temperature are well developed. The infant is more sensitive to cold than heat.

Babyhood (2 weeks to 2 years)

At first, babies are completely helpless. Gradually, they learn to control their muscles so that they can become increasingly self reliant. This change is accompanied by a growing resentment against being babied and a growing desire to be independent.

Characteristics of the Period

- *True foundation age:* During this period many behavior patterns, attitudes and emotional expressions are being established. According to Freud, personality maladjustments in adulthood is the expression of childhood experiences. Erikson also states through his theory that development of trust is essential for the child to feel that this world is secure and safe place to live.
- *Age of rapid growth and change:* Rapid change due to growth also means varied activities tending to become more independent. Individuality improves



and socialization begins. Development of concepts such as that of space, weight, time, beauty etc begins.

- *Beginning of creativity:* As they become more independent they tend to explore. Creativity is seen in routine activities such as play and communication.
- *Sense organ:* Eye muscles are well developed and coordinated. Hearing develops rapidly.
- *Early skills:* Babies go a long way from initially learning to hold the bottle of milk in two hands to feeding themselves with spoon. They also learn to dress with assistance. They learn to scribble with a pencil or crayon and even cut paper with a scissor.
- *Speech development:* The ability to comprehend the meaning of what others are trying to communicate to them and the ability to communicate using words, gestures and expression develop.
- *Emotions:* Anger, fear, curiosity, joy and affection are some of the emotions that a baby exhibits. Babies are fearful sudden stimulus, loud noise, strange persons, dark room, etc.

Childhood (2 to 11 years)

This is divided into:

- A. Early childhood (2-6 years): Preschool or 'pregang age'. The child seeks to gain control over the environment and starts to learn to make social adjustments.
- B. Late childhood (6-11 years): It is the period of sexual maturity and beginning of adolescence. The major development is socialization. This is the elementary school age or the 'gang age'.

Characteristics of the Period

- *Skills:* The skills learnt in babyhood improves significantly. Leg skills improve such as running, galloping, climbing, etc.
- *Speech:* Vocalization and comprehension improves markedly. Children try to communicate by gestures, speech and expressions. They form three to four word sentences by age of two years and six to eight word sentences by three to four years.
- *Emotions:* Conflicts during play are common and is the reason for anger among children. They express

anger through temper tantrums, crying stamping, etc. They develop fear through scary stories, movies, etc. Jealousy develops especially when their parent's attention is diverted to other children.

- *Concept development:* Concepts such as of life and death, bodily functions, numbers, time, social awareness, etc develop.

Puberty/Adolescence (11 to 16 years)

The word puberty is derived from the Latin word *pubertas*, which means "age of manhood." It refers to the process of physical changes by which a child's body becomes an adult body capable of reproduction. Growth accelerates in the first half of puberty and reaches completion by the end.

Characteristics of Puberty

- *Is an overlapping period:* It denotes the closing years of childhood and the beginning years of adolescence
- *Lasts for two to four years:* Children who pass through puberty in two years or less are regarded as "rapid maturers," while those who require three to four years to complete the transformation into adults are regarded as "slow maturers."
- *Puberty is divided into 3 stages:* Prepubescent Stage (the secondary sex characteristics begin to appear but the reproductive organs are not yet fully developed), Pubescent Stage (the time when the criteria of sexual maturity appear-the menarche in girls and the first nocturnal emissions in boys) and Postpubescent Stage (the secondary sex characteristics become well developed and the sex organs begin to function in a mature manner).
- *Puberty is a time of rapid growth and change:* Puberty is also characterized by rapid growth and marked changes in body proportions, and is termed as "adolescent growth spurt" or the "puberty growth spurt". This growth spurt lasts for a year or two before children become sexually mature and continues for six months to a year afterward. Thus the entire period of rapid growth lasts for almost three years. The other periods of life that have rapid growth are the prenatal period and the first half of the first year of life.



- Effects on Physical Well-being
 - Increased fatigue, listlessness, and other unfavorable symptoms.
 - Digestive disturbances are frequent, and appetite is finicky. The prepubescent child is upset by glandular changes and changes in the size and position of the internal organs.
 - Anemia is common at this period, not because of marked changes in blood chemistry, but because of erratic eating habits, which in turn increase the already present tendency to be tired and listless.
- Desire for Isolation
 - Children usually withdraw from peer and family activities and instead quarrel with them.
 - They spend much time in daydreaming
 - They also refuse to communicate with others.
- Boredom
 - Pubescent children are bored with the play they formerly enjoyed, with schoolwork, with social activities, and with life in general.
- Incoordination
 - Rapid and uneven growth affects habitual patterns of coordination, and the pubescent child is clumsy and awkward for a time. As growth slows down, coordination gradually improves.
- Social Antagonism
 - The pubescent child is often uncooperative, disagreeable, and antagonistic.
- Heightened Emotionality
 - They are very moody, sulky, with temper outbursts, and a tendency to cry at the slightest provocation.
- Loss of Self-Confidence
 - The pubescent child, lacks in self-confidence and is afraid of failure although was formerly very self-assured.

The term adolescence is derived from the Latin word 'adolescere' meaning to grow to maturity. It encompasses mental, emotional and social maturity. Adolescence is the period of psychological and social transition between childhood and adulthood.

Characteristics of Adolescence

- 'Childish' behavior diminishes
- Confusion of role exists as an adolescent is neither a child nor an adult.
- Period of 'storm and stress'. It is a period of heightened emotional tension during physical and glandular changes.
- Increased peer-group influence. This is seen in behavior, likings, way of dressing, etc.
- Gangism begins. Friends are formed based on similarity in values and interests.
- They tend to be more social and like to attend parties, play games, travel, etc.

SEQUENCE OF MOTOR DEVELOPMENT

1. Head region
 - Ocular pursuit movements – 4 weeks
 - Social smiles (response) – 3 months
 - Eye coordination – 4 months
 - Holding the head up prone position – 1 month
 - Sitting position – 4 months
2. Trunk region
 - Turning – Side to back – 2 months
 - Back to side – 4 months
 - Complete – 6 months
 - Sitting - Pulls to sitting position – 4 months
 - With support – 5 months
 - Without support – 9 months
 - Organs of elimination
 - Bowel control – 2 years
 - Bladder control – 2-4 years
3. Arms and hands
 - Defensive movements – 2 weeks
 - Thumb sucking – 1 month
 - Reach and grasp – 4 months
 - Grasp and hold – 5 months
 - Picking up object with opposed thumb – 8 months
4. Legs and feet
 - Hitching(backward movement in sitting position) – 6 months
 - Crawling – 7 months
 - Creeping on hand and knees – 8 months
 - Standing with support – 9 months
 - Standing without support – 11 months



- Walking with support – 11.5 months
- Walking without support – 12 months

Development of Adaptive Skills

1. Hold 2 cubes – 7 months
2. Release the cube into the cup -1 year
3. Pile 3-4 blocks and scribble – 18 months
4. Copy a circle – 2 years
5. Copy a cross – 4 years
6. Copy a triangle – 5 years

Development of Language Skills

1. Babbling – 6 months
2. Two words + mama and dada – 1 year
3. 10 words – 18 months
4. 3 word sentence and use of personal pronouns -2 years
5. Full name, some plural, proper naming of 8 pictures – 3years
6. Loss of infantile articulation – 5 years
7. Correct plurals and tenses – 6 years

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Chapter 8



Behavior Management in Dental Practice

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INTRODUCTION

One of the most important aspects of treating a child patient is the management of the behavior. Without the child's cooperation dental treatment becomes difficult if not impossible. Most of the children enter the dental clinic with some kind of fear and anxiety which is usually transferred to him from parents, relatives, friends or it may be just an imagination.

DEFINITIONS OF SOME OF THE WORDS REGULARLY USED IN THIS CHAPTER

Behavior pedodontics – Defined as a 'discipline which focuses upon the psychological, social and learning problems of children and adolescents as they relate to the dental situations'.

Behavior – 'As any change in the functioning of an organism'

Behavior management – (Wright, 1975) 'Means by which the dental health team effectively and efficiently performs treatment for a child and at the same, installs a positive dental attitude'.

Behavior shaping – 'It is that procedure which very slowly develops behavior by reinforcing successive approximations of the desired behavior until the desired behavior comes to be'. It is sometimes called as 'Stimulus-Response Theory'

Fear – 'Physiopsychological response to a realistic threat or danger to one's existence'

Anxiety – 'Fear of the unknown'

Phobia – 'Pathological fear, attached to a certain stimulus learned in his career'. It is deep seated and is provoked by any stimulus which resembles the original episode.

FEAR

According to Sidney Finn, fear is a primary emotion for survival against danger, which is acquired soon after birth. Most of the time parents instill the fear of dentistry in their children as a means of punishment. Fear should be channeled in the correct direction such as those that causes harm to the child's existence or well being. Children should be taught that dental office is not a place to fear, and the parents should never employ dentistry as threat.

Types of Fear

Objective Fear

They are produced by direct physical stimulation. They are the responses to stimuli that are felt, seen, heard, smelt or tasted and are not liked or accepted.

Objective fear of dentistry usually is the result of previous improper dental handling. They fear white uniforms and smell of certain drugs and chemicals in hospital. It is the responsibility of the dentist to change the fear by tender loving care and gaining confidence.

Subjective Fear

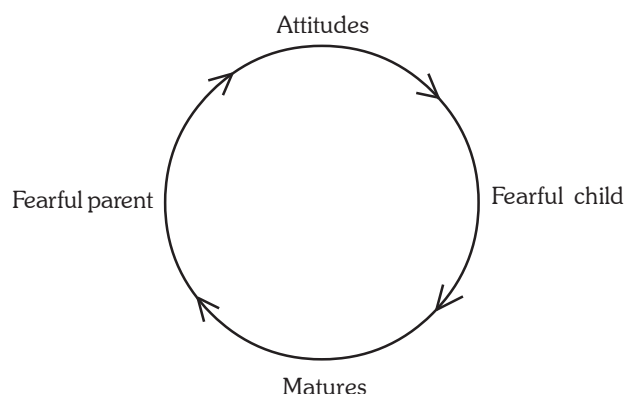
Most of the children would not have visited a dental clinic before, but are afraid of the dental procedures. These are based on the feelings and attitudes that have been suggested to the child by others about dentistry without the child having had the experience personally. Parents may tell the child about an unpleasant or pain producing situation undergone by them and this fear may be retained in the child's mind.

Subjective fear are of 2 types: suggestive and imaginative

Suggestive fear: It may be acquired by observing fear in others and then the child develops a fear for the same object as real and genuine. Child's anxiety is closely correlated with parental anxiety. Children frequently identify themselves with parents. If the parent is sad the child feels sad and if the parent displays fear the child is fearful.

Imaginative fear: A mother who fears going to the dentist may transmit this unconsciously to her child who is observing her. Such kind of fear may be displayed by the parent and acquired by the child without either being aware of it and are deep seated and difficult to eradicate. Even a clenching of the child's hand in the dental office in an unconscious gesture can create suspicion and fear in the child.

A fearful child matures to become a fearful parent and a fearful parent produces a fearful child leading to a vicious cycle.



Changes in Fear Perception with Age

The expression and intensity of child's fear varies with emotions, illness and age. The sleepy child shows more fear and irritation than the widely awake child, because he has a lower tolerance to discomfort. A physically healthy child will respond more actively than the child who is weak and medically handicapped. A mentally alert child will respond more intelligently and rapidly than the mentally retarded individual.

2-3 Years

It is the right time to introduce the child to dentistry. At this age they are less afraid of the new people and the surrounding. This is also the appropriate time to begin any preventive procedures.

3-4 Years

Fear of separation and abandonment prevails in this age group. They think and feel that dentistry is a mode of punishment. As Frankel (1961) demonstrated it is advised to allow parents in the operatory during dental treatment. This makes the children and also the parents that those children less than 4 years benefited considerably by the presence of the mother in the operatory during dental treatment. Children over 4 years of age showed no difference in behavior whether the mother was present or absent from the operatory.

At 4 years of age, the peak of definite fears is reached and from 4-6 years there is a gradual decline in the earliest fears such as those of falling, of noise etc. The decrease in the fear may be due to:

- Realization that there is nothing to fear
- Social pressure to conceal fear
- Social limitation
- Adult guidance

During this period fantasy plays a role, and gains comfort and the courage to meet the real situation.

Intelligent children display more fear because of their greater awareness of danger and reluctance to accept verbal assurance.

At 7 Years

The child tries to resolve real fears. Family support is important in understanding and overcoming his fears. He can reason and convey to the dentist when pain is being inflicted by gesture.

8-14 Years

He learns to tolerate unpleasant situation and has marked desire to be obedient. He develops considerable emotional control.

Teenage

They become concerned about their appearance. The dentist as motivation for seeking dental attention can use this interest in cosmetic effect.

Nature of Fear

The emotional stimulus is released or discharged by way of the automatic nervous system through hypothalamus, which is modified by cortical interference, so that man can control his emotions. In young children who cannot rationalize, behavior is produced which is difficult to control. As a child's mental age increases these responses can be controlled more and more by the cortex through higher psychic functions.

Value of Fear

Fear is of great value, when it is given the right direction. Fear helps people to be prepared against danger. It should be channeled in the direction of real danger and in this way, it will act as a protective mechanism against real danger. Since dentistry or dental procedures are



not threat, dentistry should never be used as a threat to children.

FACTORS INFLUENCING CHILD'S BEHAVIOR (FIG. 8.1)

1. Factors involving the child
 - A. Growth and development
 - B. I.Q of the child
 - C. Past dental experience
 - D. Social and adaptive skill
 - E. Position of the child in the family
2. Factors involving the parents
 - A. Family influence
 - B. Parent-child relationship
 - C. Maternal anxiety
 - D. Attitude of parents to dentistry
3. Factors involving the dentist
 - A. Appearance of the dental office
 - B. Personality of the dentist
 - C. Time and length of appointment
 - D. Dentist's skill and speed
 - E. Use of fear promoting words
 - F. Use of subtle, flattery, praise and reward.

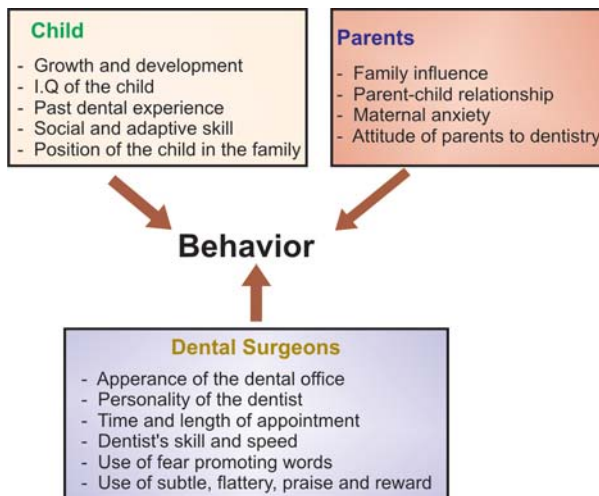


Fig. 8.1: Factors influencing child behavior

Factors Involving the Child

Growth and Development

Growth is defined as an increase in size, whereas the development is progression towards maturity. Both

proceed in a relatively predictable logical step like sequential order. These processes are influenced by genetic, familial, cultural, interpersonal and psychic factors.

Most children demonstrate emotional maturation along with physical growth. During maturation the child's behavior is systematically affected by the inherent genetic makeup. With each new experience, a new behavior develops as directed by the child's internal system from his motivation and from the consequences of his behavior. Therefore parameters that influence behavior depends upon the biologic, cognitive, emotional, perceptual, personality, social and language development.

IQ of the Child

Intelligent quotient (IQ) is the method of quantifying the mental ability in relation to chronological age formulated by Alfred Binet in the early 1900's.

$$\text{Formula - IQ} = \frac{\text{Mental age}}{\text{Chronological age}} \times 100$$

It is measured by tasks, examining memory, spatial relationship, reasoning etc. There are several other tests—For example—Wechsler pre-school and primary scale of intelligence (WPPSI), Wechsler intelligence scale for children revised (WISC-R) etc.

Positive relationship exists between IQ and acceptance of dental treatment.

Past Dental Experience

Any previous painful experience will lead to fear in the child. It is very important to remove this fear before one can accept a tolerable behavior.

Social and Adaptive Skill

An important aspect of the overall functioning is the level of the child's social and adaptive skills. It is important to consider how effective the child is in meeting the standards for personal independence and social responsibility in everyday situations.

The best known tests in this are the AAMD scale (American Association of Mental Deficiency), Adaptive Behavior Scale and Vineland Adaptive Behavior Scale.



Position of the Child in the Family and Child's Behaviour (Ordinal – Position Syndrome)

1. *First child*: Uncertainty, mistrustfulness, insecurity, shrewdness, stinginess, dependence, responsibility, authoritarianism, jealousy, sensitive
2. *Second child*: Independence, aggressive, extrovert, funloving, adventuresome
3. *Middle child*: Aggressiveness, easily distracted, inferiority and prone for behavior disorders.
4. *Last child*: Secure, confident, immature, envy, irresponsible, spontaneous good and bad behavior.

Factors Involving Parents

Family influence

The environment at home is an important factor in the development of a child's personality and his behavior patterns. Socioeconomic status of parents influences the behavior of the child and the way parents deal with the behavior. It is found that parents belonging to low socioeconomic status show authorization in controlling the child than middle and high-income group.

Mother's nutritional status and state of physical health can affect the neurologic as well as somatic development of the fetus which directly influences the children's mental, physical and emotional development.

Bell has termed the parent-child relationship as "one tailed", since parental characteristics are viewed as having a unilateral influences on those developing in the child. According to this theory, the child's characteristics including the personality, behavior and reaction to stressful situation are the direct product of various maternal characteristics. It was found that loving mothers tend to have calm, happy children, while hostile mothers tend to have children who are excitable and unhappy.

Parent-Child Relationship

Most of the relevant mother-child relationship falls into two broad categories-

1. Autonomy vs control
2. Hostility vs love

Maternal attitudes and behavior have been described and rated in relation to these two categories.

Mothers who allowed autonomy and who expressed affection had children who were friendly and cooperative. Conversely, punitive mothers and those who ignored their children did not exhibit these positive behavioral characteristics. Friendly, cooperative child will probably also exhibit these traits in the dental office.

Characteristics of parent child relationship that may influence child's behavior in dental clinic are:

1. Over protective/Over anxious parents
2. Over indulgence
3. Under affection and rejection
4. Domination
5. Identification
6. Authoritarian

Over Protective/Over Anxious Parents

Factors responsible for maternal over protection may be-

- History of previous miscarriage
- Long delay in conception
- Family's financial condition
- Death of a sibling
- If mother is aware that she cannot have another child
- Serious illness or handicapped condition
- Parental absence by divorce or death

Characteristics of the overprotective child

- Parents show undue concern for the child
- Child is always made to feel babyish
- The child is not permitted to play alone
- They are usually shy, timid and fearful
- Lack ability to make decisions
- Cooperative dental patients.

Over indulgence: The parents give the child whatever the child asks like toys, candies etc and they usually place very little restraint upon their child's behavior.

Characteristics of the over indulged child

- Spoiled child who is accustomed to getting his own way.
- His emotional development is impeded and he is aggressive, demanding and displays temper tantrums.
- In the dental office, when they cannot control the situation they may show bursts of temper.



Under affection and rejection: The extent of neglect may vary from mild detachment to total neglect.

Characteristics the child suffering from under affection and rejection

- The children appear well behaved.
- They usually develop resentment and become completely withdrawn to a shell.
- There is lack of love and affection and the child usually lacks a feeling of belonging or worthiness.
- Some children may show anxiety, cry easily and will resort to any behavior to attract attention. Such children are usually demanding.

Domination: Parents with this attitude demand from their children excessive responsibility, which is incompatible with their chronological age. They cannot accept the child as he is, but compare him with others.

Characteristics of the child having dominating parents

- Associated with resentment, evasion, submission and restlessness.
- They are fearful of resisting openly and will obey commands slowly. With kindness and consideration they generally develop into good dental patients.

Identification: Some parents try to relive their own lives in those of their children. They attempt to give the child every advantage denied to them. If the child does not respond favorably, the parent shows disappointment and the child has a feeling of guilt.

Characteristics of the child:

- The child cries easily and lacks confidence.
- These children should be handled kindly and with consideration.

Authoritarian: Such parents choose non-love-oriented techniques for controlling child behavior. Discipline takes the form of physical punishment or verbal ridicule. The mother feels that the child should follow her set of ideas.

Characteristics of the child with authoritative parents

- The response of the child will be submission, coupled with resentment and evasion.

Maternal Anxiety

Highly anxious parents tend to affect their child's behavior negatively. Children under the age of 4 years are affected greatly by mothers anxiety.

Attitude of Parents to Dentistry

Parents with positive dental attitude will develop the same in the child. Whereas a fearful parent may develop fear unknowingly in a child.

Factors Involving the Dentist

Appearance of the Dental Office

Since the child may enter the dental office with some fear, the first objective of the dentist is to put the child at ease. To achieve this, the reception room should be made as comfortable and warm as possible (Fig. 8.2A).

Children's chairs and tables with a small lamp and shade should be made available where they can sit and read. Small toys can be kept in the room to amuse very young child. A music player with chosen music helps to comfort the frightened child. An aquarium with colored fishes can be placed in one corner of the room. Cartoon characters can be hung on the wall. The assistant can make animals out of cotton wool, which can prove very amusing to children. Puzzles and story books suitable for different age group should be placed on a neat and attractive rack.

Try to avoid children seeing adults in pain. They can be made to leave the clinic through another door. It is important that the office assistant, receptionist and the dental hygienist also show enthusiasm, as the children are extremely sensitive to hidden emotions.



Fig. 8.2A: Colorful atmosphere of the reception eases the child's fear



Fig. 8.2B: Doctors should be friendly and playful to make the child at ease

Personality of the Dentist

The approach of the dentist should be casual, confident and friendly towards the child (Fig. 8.2B). The dentist must be in command of the situation and modify any behavior that interferes with the dental treatment. The dental surgeon should never lose his temper as this will create a feeling of success in the mind of the child and will ruin the child for all future dental visits.

When approaching a new child patient, always call him by his or her nick name or at least the first name. All conversation should be directed towards him. Do not talk in a loud voice or shake hands vigorously. Approach the child with confidence in your voice.

The dentist's conversation must be directed to the subject of interest to the child and never underestimate the intelligence of the child.

The dentist can help the child to display good behavior by –

- Gaining the confidence of the child that we are there to help
- Permitting children to express their feeling and being a good listener oneself
- Making children feel that their reactions are understood
- Comforting children when it is appropriate
- Encouraging children when they show acceptable behavior.

Time and Length of Appointment

When dealing with children both the time and the length of appointment are important. Children cannot sit in one position for longer time and their threshold of tolerance is very low. Therefore they should not be kept in the chair for periods longer than half an hour. With longer appointment they tend to become less cooperative. Once a child loses his self-composure his cooperation is very difficult to regain.

Children should not be given appointment during their naptime or soon after some emotional experience such as birth of a sibling or death of some one close. At these times, cooperation may be difficult to secure and emotional difficulties are likely to be encountered.

Dentist's Skill and Speed

The dentist should perform his duties with dexterity, in a preplanned manner to avoid any loss of time. A child can endure discomfort if he knows it is soon going to end.

Avoiding the use of Fear Promoting Words

The use of fear promoting words such as needle, injections etc should be avoided. The words that can be used alternatively are called as euphemisms.

<i>Eg: Euphemisms</i>	<i>Actual word</i>
Mosquito bite	→ needle prick
Rain coat	→ rubber dam
Tooth button	→ rubber dam clamp
Coat rack	→ rubber dam frame
Tooth paint	→ sealant
Cavity fighter	→ fluoride
Wind gun	→ air syringe
Vacuum cleaner	→ suction
Pudding	→ alginate
Motor cycle	→ hand piece/bur

Use of Subtle, Flattery, Praise and Reward

One of the most important rewards sought by the child is the approval of the dentist. In praising a child, it is better to praise the behavior than the individual. Tiny gifts such as alphabet erasers, tiny gold stars, toys or



stickers make good gifts. It is the recognition more than the material that makes the child happy. Flattery can also be used as a reward after the treatment. It can be a pat on the back, praise or a gift (Fig. 8.3).



Fig. 8.3: Type of gifts that can be given to children

PARENT COUNSELING

Parent education is very important to get a satisfactory rapport between the entire family and the dentist. Some points to be discussed are as follows

- Parents should not voice their own personal fears in front of the child.
- Parents should never use dentistry as a threat or punishment.
- The parents should familiarize their child with dentistry by taking the child to the dentist along with sibling or themselves
- Parents should themselves be bold and display courage in dental clinic
- Importance of parental attitude and home environment in building confidence in a child should be stressed.
- Regular dental care helps in preventing dental disease and also helps in the development of positive attitude towards dentistry.
- Discourage parents from bribing their children.
- The parent should be instructed never to scold, shame or ridicule to overcome the fear of dental treatment.
- Outsiders like friends or relatives should be discouraged from exhibiting their fear in front of the child.

- The parent should not promise the child what the dentist is not going to do. Lying only leads to disappointment and mistrust.
- Several days before the appointment, the parent should be instructed to convey to the child in a casual manner that they have been invited to visit the dentist.

CHILD PARENT SEPARATION

As early as 1898, Belcher noted that excluding the parents from the operating room could contribute towards developing the child's positive behavior. There are both group of dentists, one who agree with the parent's presence in the operatory, and second who disagrees.

The advantage of not allowing the parents in the operatory are:

1. Parents often repeat order, creating an annoyance for both dentist and child patient.
2. The parents inject orders which become a barrier to development of rapport between the dentist and child.
3. The dentist is unable to use voice control in the presence of the parent because the parent may be offended.
4. The child's attention is divided between parent and the dentist.
5. The dentist's attention is divided between parent and the child.

The advantage of allowing the parents in the operatory are:

1. A parent can be a major asset in supporting and communicating with the child, such as a handicapped child.
2. Another important exception is related to the age factor. Children below 2-3 years find it difficult to express and reach proper communication with the dentist and vice-versa.
3. Young children are prone to a number of fears, including fear of the unknown and of abandonment. They also lack the ability to adjust to a new situation or environment. The mother's presence can serve to reduce the fears of the young child and can offer emotional support during this experience.



CLASSIFICATION OF CHILDREN'S BEHAVIOR

Wright's Classification of Behavior (1975)

Co-operative Behavior

- Reasonably relaxed, have minimal apprehension and can be treated by a straight forward behavior shaping approach.
- Have or develop good rapport with the dentist and are interested in the dental procedure
- Laugh and enjoy the situation
- Allow the dentist to function effectively and efficiently.

Lacking Co-operative Behavior

- This behavior is contrast to co-operative child
- Includes very young child (<2 ½) or with specific debilitating or handicapping conditions
- They can pose major behavioral problems.

Potentially Cooperative Behavior

- Differs from a child lacking cooperative ability in that this child is able to co- operate and is physically and medically fit.
- When classified as potentially cooperative, the judgement is that the child's behavior can be modified. This group of children are the one who require behavioral modification procedures.
- *Potentially cooperative group are further categorized as follows:*

Uncontrolled behavior

- Seen in 3-6 years.
- Tantrum may begin in the reception area or even before.
- This behavior is also called as 'incurable'.
- Tears, loud crying, physical lashing out and flailing of the hands and legs- all suggestive of a state of acute anxiety or fear.
- School aged children tend to model their behavior after that of adults.
- If it occurs in older children, there may probably be deep rooted reasons for it.

Defiant behavior

- Can be found in all ages, more typical in the elementary school group.
- Distinguished by "I don't want to" or "I don't have to" or "I wont".
- They protest when they are brought to the dental clinic against their will, as they do at home.
- Also referred to as "stubborn" or "spoilt".
- Once won over, these children frequently become highly cooperative.

Timid behavior

- Milder but highly anxious.
- If they are managed incorrectly, their behavior can deteriorate to uncontrolled.
- May shield behind the parent.
- Fail to offer great physical resistance to the separation.
- May wimper, but do not cry hysterically.
- May be from an overprotective home environment or may live in an isolated area having little contact with strangers.
- Needs to gain self confidence of the child.

Tense cooperative behavior

- Border line behavior
- Accept treatment, but are extremely tense
- Tremor may be heard, when they speak
- Perspire noticeably

Whining behavior

- They do not prevent treatment, but whine throughout the procedure
- Cry is controlled, constant and not loud
- Seldom are there tears
- These reactions are at times frustrating and irritating to the dental team
- Great patience is required while treating such children

Frankl's Behavior Rating Scale (1962)

- A. Rating No. 1 – *Definitely Negative*
- Refuses treatment
 - Immature, uncontrollable



- Defiant behavior
- Crying forcefully
- B. Rating No. 2 – *Negative*
 - Reluctance to accept treatment
 - Immature, timid and whining
- C. Rating No. 3 – *Positive*
 - Accepts treatment
 - Tense co-operative
 - Whining and timid
- D. Rating No. 4 *Definitely Positive*
 - Good rapport,
 - Understanding and interested

Wright (1975) Added Symbolic Modifications

Wright (1975) added symbolic modifications to the Frankl's rating scale and made it more applicable and easier to understand child behavior

- Rating no. 1 – definitely negative (- -)
 Rating no. 2 – negative (-)
 Rating no. 3 – positive (+)
 Rating no. 4 – definitely positive (++)

Lampshire's Classification

- A. *Co-operative*: The child is physically and emotionally relaxed and is co-operative throughout the entire procedure.
- B. *Tense cooperative*: The child is tensed, and co-operative at the same time.
- C. *Outwardly apprehensive*: Avoids treatment initially, usually hides behind the mother, avoids looking or talking to the dentist. Eventually accepts dental treatment.
- D. *Fearful*: Requires considerable support so as to overcome the fears of dental treatment.
- E. *Stubborn/Defiant*: Passively resists treatment by using techniques that have been successful in other situations.
- F. *Hypermotive*: The child is acutely agitated and resorts to screaming kicking, etc.
- G. *Handicapped*: Physical or mental.
- H. *Emotionally immature*: Emotionally handicapped

Kopel's Classification (1959)

- Very young patient
- Emotionally disturbed patient, such as
 - Child from a broken or poor family
 - Pampered or spoiled child
 - Neurotic child
 - Excessively fearful child
 - Hyperactive child
- Physically handicapped child
- Mentally handicapped child
- Child with previous untoward medical or dental experience

OBJECTIVES OF BEHAVIOR MANAGEMENT

1. To establish effective communication with the child and the parent
2. To gain the confidence of both the child and the parent and the acceptance of dental treatment
3. To teach the child and the parent, the positive aspects of preventive dental care
4. To provide a relaxing and comfortable environment for the dental team to work in, while treating the child.

CHILD'S FIRST DENTAL VISIT

It is generally recommended that a child's first visit be made at about 3-4 years of age. The degree of cooperation exhibited by preschool children at their first appointment is high.

Maternal anxiety plays an important role in the child's reaction in dental clinic. Various other factors may also influence (Already discussed under Factors influencing child's behavior) the behavior of a child on the first visit.

The first visit usually involves only examination, radiographic evaluation and if possible a prophylaxis and topical fluoride treatment unless the child presents with an acute dental problem.

It should be remembered that fear of abandonment is high in younger children and may lead to anxiety



during taking of the radiograph leading to uncooperative behavior. It is advised that parent hold the radiograph in the child's mouth while taking the radiograph so that the child feels secure. Very young children should not be separated from the parents or left alone on the dental chair.

Except for the emergency treatment or noninvasive procedure it is wise not to perform any other treatment during the first visit, even in a very co-operative child.

BEHAVIOR MANAGEMENT

Behavior management is a complex problem that requires a team effort involving the parent, the dental staff and sometimes even the teacher.

Principles of behavior management technique is as following:

1. Anticipation: Explaining the child regarding the procedure and answering the question regarding dentistry and procedures. This can be done through Tell Show Do approach, Good communication etc.
2. Diversion: Diverting the child's attention away from fear producing situation may calm the child and allow the dentist to perform the treatment without disturbance. Audioanalgesia, Hypnodontics etc.
3. Substitution: It involves substituting unwanted behavior by an accepted behavior. This can be done by contingency management, modeling etc.
4. Restriction: Restricting a child from exhibiting unwanted behavior. This can be achieved through physical restrains or pharmacological behavior management technique.

Behavior management can be achieved by basically two methods

1. Nonpharmacological methods
2. Pharmacological methods

Nonpharmacological Methods

Various techniques are

- A. Preappointment behavior modification
- B. Communication

C. Behavioral shaping

- Tell-show-do technique
- Desensitization
- Modeling
- Contingency

D. Behavioral management techniques

- Audioanalgesia
- Voice control
- Hypnodontics
- Coping
- Relaxation
- Aversive conditioning
- Implosion therapy
- Retraining

Preappointment Behavior Modification

It is aimed at preparing the child for a dental visit. Various methods used for pre appointment behavior modification includes audiovisual aids, letters, films and videotapes. Children are explained the importance of maintaining the teeth in health. Video clipping may include other children undergoing dental treatment so that the child will feel the similarity and reproduce the behavior exhibited by the model. Preappointment behavior modification can also be performed with live patient as models such as siblings, other children or parents.

Mails can be sent addressed to the child that provides brief information regarding the procedure. It is called as pre appointment mailing. Parents can also be given advice for preparing the child for their first dental visit.

Communication

The hallmark of a successful dentist in managing child dental patient is his ability to communicate with them and win their confidence. The fears and the natural innate curiosity of a child predict that explanations must be given for new or different techniques and procedures. Communication forms one of the essential features of the tell-show-do technique.

*Objectives of communication*

- a. *Establishment of communication:* Communication helps the dentist to learn about the child and makes the child at ease and relaxed. But this should not be overdone. Some children realize that by controlling conversation, they can exert considerable influence over their environment.
- b. *Establishment of the communicator:* Communicator may be any person in the clinic who can provide information. Initial communication is provided by the receptionist who welcomes the child and the parent with the smile. This initial communication is very important in building confidence and projecting the attitude of the clinic staff to the patient. The dental assistant should talk to the child during the transfer from reception room to operatory and during the preparation of the child in the dental chair. When the dentist arrives, the assistant usually takes a more passive role, as the child can listen to one person at a time.
- c. *Message clarity:* Message content varies from a hearty good morning to relevant information and thank you. Message should be simple and easy to understand by a young child. Euphemisms can be used. While talking to a child it is important to remember certain points. They are
 - The child may not respond to a question immediately. It takes more time for the question to 'sink in' than for adults
 - The command that are given should be simple and within the ability of the patient to obey
 - All command's should be given in a positive language since the negative approach may tend to stimulate fear. Example – "Do Not move" is avoided and replaced by "I can't fix your teeth until you sit still"

Behavioral Shaping

It is based on the stimulus-response theory and principles of social learning. The child is taught how to behave.

Different techniques used for behavior shaping are follows:

1. Tell-show-do technique
2. Desensitization

3. Modeling
4. Contingency

The outline for a behavior management includes

- State the general task to the child at the outset
- Explain the necessity for the procedure
- Divide the explanation for the entire procedure
- Make all explanations at a child's level of understanding
- Reinforce appropriate behavior.

Tell-show-do technique

This technique was introduced by Addleston in 1959. In this technique the child is told about the treatment, showed the instruments and then the treatment is actually performed (Fig 8.4). Thus a child who requires a restoration is told that his teeth are to be brushed or cleaned. He is shown the handpiece and how it revolves and is introduced to the child as a special brush, that cleans his teeth with water. To the TSD sequence should be added 'praise' to reinforce good behavior.

While taking radiographs the X-ray machine is introduced as a camera that takes the photo of the teeth. The child should be assured that it won't hurt him but only goes near the cheek.

This technique should be practiced every time a new instrument or object is brought near the child.

Tell Show Do technique needs to be modified while treating a child who is visually impaired. Tell-touch-Do or Tell-Smell-Do technique should be used. The child is allowed to touch, feel and smell the materials and instruments (except the sharp ones).

Desensitization

It is also called as reciprocal inhibition. It is a training procedure or steps taken to reduce the sensitivity of the patient to a particular anxiety producing situation or object. Each situation or object is then introduced progressively starting from least fear producing to more threatening stimuli.

The Technique Involves 3 Stages

1. Training the patient to relax
2. Constructing a hierarchy of fear producing stimuli related to the patient's principal fear.
3. Introducing each stimulus in the hierarchy in turn to the relaxed patient, starting with the stimulus that



A



B



C

Figs 8.4A to C: Tell Show do technique

- A: The hand piece is explained to the child
 B: The child is shown how it works and that water can be used to clean
 C: Then the hand piece is taken intraorally to do the restoration

causes least fear and progressing to the next only when the patient no longer fear that stimulus.

Example

If the child is frightened of the restoration, desensitization might include successive introduction of the child to the—

- Reception
- Dentist
- Dental chair
- Oral examination
- Oral prophylaxis
- Restoration any other required procedure

This technique requires many appointments and visits.

Modeling

This procedure involves, allowing a patient to observe one or more individuals (model) who demonstrate appropriate behavior in a particular situation. The patient will frequently imitate the model's behavior when placed in a similar situation.

Models can be – live (other children present in the operatory) (Fig 8.5).

- filmed (symbolic or vicarious). A model can be used which is not present physically. For example Mickey mouse undergoing dental treatment in picture or video format.



Fig. 8.5: Elder sibling can play the role of a model

Steps in modeling as follows

1. Obtaining the patients attention
2. The desired behavior is modeled
3. Physical guidance of the desired behavior may be necessary when the patient is initially expected to mimic the modeled behavior
4. Reinforcement of the required behavior



Modeling is a technique which yields significant benefit with minimum effort. Rather than waiting in the reception room, where they may be adversely influenced by maternal anxiety associated with the dental situation, children may be brought into an operatory immediately upon arrival to the office if a suitable model is being treated. When siblings act as model, less anxious sibling should be selected, making other one realize that there is nothing to fear and 'I too can'

Contingency management

The presentation or withdrawal of reinforcers to modify a child's behavior is termed contingency management.

Reinforcers by definition always increases the frequency of a behavior. They can be of two types-

1. *Positive reinforcers*—whose contingent presentation increases the frequency of a behavior
 2. *Negative reinforcers*—is one whose contingent withdrawal increases the frequency of a behavior
- Reinforcers Can Be Material, Social or Activity.

Material—Most effective in children are small gifts

Social—Represents the majority of all reinforcing events affecting human behavior. Praise, positive facial expression, nearness and physical contact are effective social reinforcers.

Activity—Involves the opportunity or privilege of participating in a preferred activity after performance of a preferred behavior. This is especially used at home. For example "first you work, then you play"

The anxious patient can be reassured with these reinforcers. Social reinforcers should be dispensed throughout each dental visit in a sincere manner, in response to appropriate patient behavior.

Behavior Management Techniques

Audioanalgesia: It is also called as 'white noise'. This consists of providing a sound stimulus of such intensity that the patient finds it difficult to attend to anything else. The effect is due to distraction, displacement of attention and a positive feeling on the part of the dentist that it can help.

Voice control: When normal communication tones and expression fails, voice control can be fundamental element in obtaining child's compliance. The quick change in tone and expression of the dentist is an effective method for managing negatively behaving children.

Voice control a such as sudden command to "stop crying and pay attention" is most effective when used in conjunction with other communication.

Multisensory communication: Nonverbal messages such as body contact also can be used to obtain positive behavior. The act of placing a hand on the child's shoulder conveys a feeling of warmth and friendship. Eye contact is equally important. Alert listening is also important especially in older children. Thus it allows children to express their feelings.

Hypnodontics: Use of hypnosis in dentistry is known as hypnodontics. Hypnosis is defined as a particular state of mind which is usually induced in one person by another – a state of mind in which suggestions are not only more readily accepted than in the waking state, but are also acted upon more powerfully than would be possible under normal conditions.

James Braid of England, first coined the term hypnosis and described the phenomenon as 'neuro-hypnosis'.

Four main features of hypnosis are-

1. Discontinuity from normal waking experience but different from sleep.
2. A compulsion to follow the cues given by the hypnotist both during and after the hypnotic experience.
3. A potential for experiencing as real any distortions of perception, memory or feeling based on suggestions given by the hypnotist rather than on objective reality.
4. Ability to tolerate logical inconsistency that would normally be disturbing.

Coping: Patients differ not only in their perception and response to pain but also in their ways of dealing or coping with the stress associated with painful experiences.



Same can be used to modify child's behavior in the dental clinic.

Different coping mechanisms are–

1. Distraction or displacement of attention away from the threat is an ideal method of coping. This can be achieved by constantly talking and asking interesting questions to the child.
2. Allowing the child to verbalize fears to the dentist makes the child feel secure.
3. Allowing parents to be in the operatory. The child feels secure with the parent.

Relaxation: Relaxation usually involves a series of basic exercise that may take several months to learn and which require the patients to practice at home for at least fifteen minutes each day. This technique apparently works by reducing tension, well-known potentiator of pain.

Aversive conditioning: There are 3 modes of aversive conditioning.

1. Hand over mouth technique
2. Physical restraining
3. Voice control.

This method is used as a last resort for a very young, the immature, physically handicapped or those who are mentally or emotionally afflicted.

Some dentists consider this method as punishment and some parents too have disapproved them and there have been legal considerations also.

HOME: Hand Over Mouth Exercise Also Called As Hand Over Mouth Technique

It was first described in the 1920's by Dr. Evangeline Jordan who wrote " if a normal child will not listen but continues to cry and struggle ... hold a folded napkin over the child's mouth ... and gently but firmly hold his mouth shut. His screams increase his condition of hysteria, but if the mouth is held closed, there is little sound, and he soon begins to reason."

Indication of HOME technique:

- For normal children who are momentarily hysterical, belligerent or defiant.

- Used for children with sufficient maturity to understand simple verbal commands.

Contraindication of HOME technique:

- Immature, frightened or the child with a serious physical, mental or emotional handicap

Purpose

- Gain the child's attention and to stop his verbal outburst so that communication can be established.

Technique of HOME technique

The dentist gently but firmly places his hand over the child's mouth. With the verbal outburst completely stopped, the child is told that when he cooperates the hand will be removed (Fig 8.6). When the patient indicates his willingness to cooperate, usually by a nod of the head and cessation of attempts to scream, the hand is removed and the patient is reevaluated. If the disruptive behavior continues, the dentist again places his hand over the child's mouth and tells him that he must cooperate. Once the child cooperates he must be complimented.

Other Variants of Hand Over Mouth Technique are:

- Hand-over-mouth – airway unrestricted
- Hand-over-mouth and nose – airway restricted
- Towel held over mouth -
 - Dry towel held over the mouth and the nose
 - Wet towel held over the mouth and the nose



Fig. 8.6: HOME technique



But ideally airway should never be restricted and care should be taken that the child is not a mouth breather.

Physical Restraints

Consent of the parent's should be taken prior to the use of physical restraints. They are useful and effective in facilitating the delivery of dental care for patients who need help controlling their extremities and for managing extremely resistant patients who need dental care but are not candidates for general anesthesia.

Some of the commonly used physical restraints.

For the body

- *Papoose board* (Fig. 8.7)—It is simple to use and store and is available in different sizes to hold both large and small children. It has attached head stabilizers and is reusable. Its disadvantage is that it does not fit the contour of the dental chair and sometimes a supporting pillow is needed. An extremely resistant patient may develop hyperthermia if restrained for too long.
- *Triangular sheet*—Also called bed sheet technique described by Mink. It allows the patient to sit upright during radiographic examinations. Its disadvantages include the frequent need for strapping, to maintain the patient's position in the chair, the difficulty of its use on small patients and the possibility of airway impingement should the patient slip downward unnoticed.
- *Pedi wrap*—Does not have supports or a backboard and has mesh net fabric, and permits better ventilation, lessening the chances of the patient developing hyperthermia. It is strapped to the body and maintained in the dental chair.
- *Beanbag dental chair insert*—Helps accommodate the hypotonic and severely spastic persons who need more support and less restraining in the dental chair.
- *Safety belt*—Velcro straps can be used to restrain the child to the dental chair.
- *Use of bed sheet*—Long sheets such as bed sheets can be used to wrap the child. This restricts the movement of the hands and the legs (Fig. 8.8).

- *Extra assistant*—Parents can help hold the child on the dental chair (Fig. 8.9). This also gives additional security to the child.

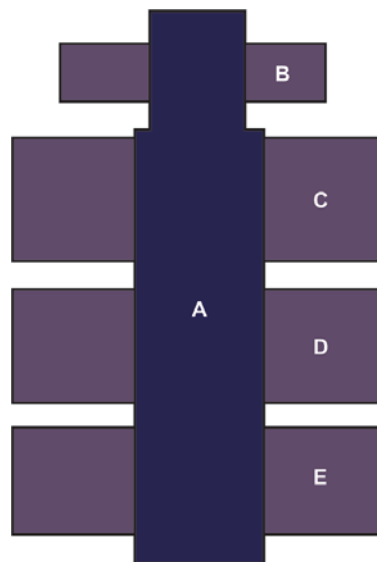


Fig. 8.7: Diagrammatic representation of a Papoose board: The child is made to lie on the centre board and straps that are present on either side of the board are wrapped over the child.

- A: Centre board
- B: Straps for the Head
- C: Straps for the Upper body
- D: Straps for the Lower body
- E: Straps for the Legs



Fig. 8.8: A long sheet wrapped around the child restrains the body and the extremities



Fig. 8.9: Mother sits on the chair and the child lies over the mother. Mother holds the child's hands and her legs are crossed over the child's legs. If the child is small, one hand can be used to restrain both the child's hands and the other preferably the left can be placed on the forehead to restrain the head.

For the extremities:

- *Posey straps* Can be used if the movement of the
- *Velcro straps* extremities are the only problem. They are fastened to the arms of the dental chair and allow limited movement of the patient's forearm and hand
- *Towel and tape*
- *Forearm body support*
- *Extra assistance*

For the head:

- Head positioner
- Plastic bowl
- Extra assistant

For the teeth

- *Padded and wrapped tongue blades (Fig. 8.10)*—Can be used by the parents to aid with home care.

Simple icecream sticks that are piled and wrapped in a gauze can be used as restrains for the teeth.

- *Mouth prop or bite block (Fig. 8.11)*—Used at times during injection to prevent children from closing their mouths or children who are fatigued from a long appointment, are stubborn or defiant or who constantly closed his mouth in order to interrupt treatment.
- *Finger guard or interocclusal thimble*—It is inexpensive and fits the dentist's finger. Its main disadvantage is the limited mobility of the dentist's hand once the splint is in place.



Fig. 8.10: Ice cream sticks wrapped with gauze can be used as restraint for the mouth



A



B

Fig. 8.11: Rubber bite blocks; A: They are available in different sizes; B: Bite block placed in between the teeth



Two types of mouth prop are molt mouth prop and rubber block

Molt mouth prop—Available in adult and child sizes, allows accessibility to the opposite side of the mouth and operates on a reverse scissor action. Its disadvantages include the possibility of lip and palatal lacerations and luxation of teeth if it is not used correctly. The patient's mouth should not be forced opened beyond its natural limits.

Rubber bite blocks—They are available in different sizes and should have floss attached for easy retrieval if they become dislodged in the mouth.

Voice Control—The dentist can at times raise his voice and instruct the child in short but strict commands. This also makes the child realize that it is the dentist who is “in charge” rather than the child.

Implosion Therapy

In this technique the patient is flooded with many stimuli. The child has no other choice but to face it until the negative behavior disappear. It comprises of Home technique, voice control and physical restraints together.

Retraining

It is required for children displaying considerable apprehension or negative behavior. The demonstrated behavior may be the result of previous dental visit or the effect of improper parental or peer orientation. During retraining, the objective is to build new series of associations in the child's mind. If a child had an unpleasant experience in the previous dental office, and is taken to another dental office, the child still tends to generalize that an unpleasant event will occur in this new dental office also. This is known as “stimulus generalization”. To remove this generalization, the dental team has to demonstrate a ‘difference’ and create new stimulus which is pleasant and replaces the old.

Pharmacological Behavior Management

To perform the highest quality dental service for the pediatric patient one may need to utilize pharmacological means to obtain a quiescent, co-operative patient.

Terms and Definition

- A. *Sedative*—A drug that subdues excitement and calms the subject without inducing sleep, though drowsiness may be produced.
- B. *Hypnotic*—A drug that induces and/or maintains sleep, similar to normal arousal sleep.
- C. *Conscious sedation*—Is a minimally depressed level of consciousness in which the patient's ability to maintain a patent airway independently and continuously and to respond appropriately to physical stimulation or verbal command is retained.
- D. *Deep sedation*—Controlled state of depressed consciousness or unconsciousness from which the patient is not aroused easily. It may be accompanied by partial or complete loss of protective reflexes including the ability to maintain a patent airway independently and respond purposefully to physical stimulation or verbal command.
- E. *General anesthesia*—Controlled state of unconsciousness accompanied by loss of protective reflexes, including the ability to maintain airway independently and respond purposefully to physical stimulation or verbal command.
- F. *Tranquilizer*—Can be major tranquilizer (anti psychotics) or minor tranquilizer (anti anxiety). Anti psychotics produce calmness, control symptoms of psychosis, cause reversible extrapyramidal symptoms and do not tend to cause habituation. Used for treatment of delusion, excited or psychotic states. Anti anxiety agents produce calmness but to lesser degree, do not possess antipsychotic properties or cause extrapyramidal symptoms. Used in the treatment of common psychoneurotic states such as nervous tension and mild depression.

Indications for Pharmacological Behavior Management Techniques

Pharmacological behavioral management are especially useful in children who are either extremely young, have reduced mental capacity, are intensely fearful or have severe medical problems which affect their ability to be co-operative.



Different types of Pharmacological Behavior Management Techniques

1. Premedication
2. Conscious sedation–parental/inhalation
3. General anesthesia

Premedication

Guidelines for the use

1. Detailed medical history should be taken to prevent undesired drug interaction
2. Decision to use premedication – should be done before one resorts to sedatives, conscious sedation or General anesthesia.
3. Selecting a premedication agent – depends upon the properties, effects, dosage, duration of action, hypersensitivity, etc. The type and dosage used should never impair the vital reflexes of the child.
4. Consent and pre operative instructions should be given before any procedure. This reduces parent anxiety. Instructions includes the method of administration of the drug, its safety precautions, side effects of the drugs, dietary precautions etc. Parents should accompany the child.
5. High levels of personnel training is a must
6. Call for documentation of events during the treatment (vital signs, etc.)
7. Assistant other than the operator must participate in the procedure to constantly monitor physiological parameters.
8. Postoperative care includes – discharge only when vital signs are stable, patient is alert, can walk with minimal assistance

Administration of premedication: It is better to administer premedication in the dental office as the dentist can use routes other than oral and also accurate timing of the administration can be done. Frequently parents fail to observe the time of administration, or may fail to report vomiting or incomplete ingestion. Another advantage of office administration is that treatment can be begun at the time of optimum effect on the child who responds quickly to the drug, whereas if the drug is administered at home, the child may be in transit during peak drug activity.

Care during Premedication

- Child should never be left unattended
- To enhance drug efficacy the child's environment should be kept as quiet as possible.
- The child who is aroused before the medication has reached peak activity may remain excited and the child who receives additional premedication before peak activity is reached may be overmedicated. Once the desired level of sedation is obtained it is still essential to administer local anesthesia. A sedated child aroused by painful stimuli may display considerable agitation and confusion.

Postoperative instruction:

- After the completion of the treatment the child whether is asleep or awake, will be in a sedated condition.
- The child may sleep for many hours, depending on the drug and the dosage used.
- Upon awakening, the child may complain of hunger or thirst if the sleep has been prolonged. The mouth and pharynx may be dry, so it is better to start with little water and then to proceed with other food.
- Recovery period may be extended for several hours and should be under supervision.

Factors influencing dosage

- A. *Age:* Young's rule has not been found to be an effective method of determining premedication dosage. Of the numerous dosage tables based upon age that have been prepared for premedicating agents, those that have been prepared from clinical experience with various dosage levels suggested for each age group probably suggest more adequate dosage levels than do young's rule.

$$\text{Dosage} = \frac{\text{age} \times \text{adult dose}}{\text{age} + 12}$$

- B. *Weight:* Clarke's rule is better for premedication prescription than Young's rule and is calculated based on the child's body weight.

$$\text{Dosage} = \frac{\text{Body Wt. (Kg.)} \times \text{Adult Dose}}{150}$$



- C. *Emotional State and Activity*: Extremely anxious or defiant child will require more premedication than will the mildly apprehensive child. The child who displays greater physical activity will usually require higher dosage than will a child who is more passive.
- D. *Route of Administration*: Drugs given intravenously will act more rapidly and are given in lower dose, whereas a drug given orally act more slowly and dosage requirement are higher. Intramuscular administration of drugs results in intermediate onset of action and dosage requirements.
- E. *Environment*: Dosages required are generally lower when a drug is taken in a non stress full (lying in a bed) environment and when the patient is expected to remain quite. Conversely the amount of drug required is usually higher when an anxious patient requires premedication in the dental office, where auditory, tactile and visual stimulation can be intense.
- F. *Time of the Day*: Dosage may sometimes be reduced if given during the time when the child usually takes a nap. Conversely dosages may have to be elevated if the drug is administered during the time when the child is usually engaged in active play.

General causes of premedication failure

- Prescription of an insufficient dose of drug
- Accidental or intentional reduction of dosage by the parents
- Failure of the child to co-operate in swallowing premedication
- Expectoration or vomiting of a portion of the medication
- Children with medical condition such as brain damage and other problems are often inadequately premedicated and may require increased doses or different drugs.

Conscious Sedation

Conscious sedation helps achieve co-operation in a child by reducing their anxiety but maintaining the conscious state of the child.

Definition

Defined as “a minimally depressed level of consciousness in which the patient’s ability to maintain a patent airway independently and continuously and respond appropriately to physical stimulation and or verbal command is retained” (Am. Ac. Ped. Dent. 1993)

Indication of conscious sedation:

- For nervous and apprehensive children
- Limited degree for uncooperative and defiant children

Aides in –

- Erasing fear, anxiety and apprehension
- Helps to reduce patient motion
- Creates a semihypnotic state
- Increases tolerance for longer appointments
- Slightly raises the pain threshold
- Maintaining the conscious of the child

Advantages

- Patient is conscious
- Relative safety
- Least disturbs the metabolic process and general functions
- Has all vital reflex intact
- Can communicate and cooperate
- Quickly returns to normal state after few minutes
- Rapid onset and recovery time, because of very low plasma solubility
- Ease of dose control
- Lack of serious adverse effects
- Produces euphoric effect

Disadvantages

- Weak agent – not so affective in moderate or severely anxious patients, as dose cannot be increased
- Lack of patient acceptance – some may not like it
- Inconvenience – when inhalation is used the mask may hinder exposure of the oral cavity especially in children
- Potential chronic toxicity – retrospective survey studies of dental office personnel who were exposed to trace levels of N₂O suggests a possible association



with and increased incidence of spontaneous abortions, congenital malformations, certain cancer, liver disease, kidney disease and neurologic disease.

Contraindication

- Severely unco-operative child
- Hypersensitivity to the agent
- Chronic obstructive pulmonary disorder
- Psychiatric patients
- Cardiac patients
- Epilepsy, bleeding disorder

Patient evaluation

The child patient must be properly evaluated prior to the treatment procedure.

Detailed history regarding allergies, current medications, diseases, previous hospitalization, family history, respiratory obstruction etc. and vital signs like pulse, blood pressure etc should be checked.

American society of anesthesiologists – risk assessment:

CI I – No organic, physiological, biochemical or psychiatric disturbance

CI II – Mild to moderate systemic disturbance without significant physical limitation

CI III – Severe systemic disturbances with physical limitation (steroid depended asthma or severe mental retardation)

CI IV – Life threatening disorder (renal disorder)

CI V – Moribund patient – who has little chance of survival

CI I and CI II are patients considered fit for receiving sedation in dental office

Patient consent: The parents or legal guardians must be agreeable to the use of conscious sedation for the child. They should be well informed regarding the risk, benefits and associated particulars. Written consent must be obtained prior to the procedure.

Instruction to the parents: It includes information regarding the intake of food and liquids – Food may interfere in the absorption of the drug and if there is vomiting the contents can get aspirated and cause aspiration pneumonia or laryngospasm. Hence it is better to avoid food before the sedation appointment.

Children < 3 years – may have clear liquid upto 4 hours before procedure

3-6 years – upto 6 hours

> 7 years – upto 8 hours

Routes of Administration of the Drug

- Inhalation e.g., nitrous oxide
- Oral
- Rectal
- Parental
 - Intravenous
 - Intramuscular
 - Submucosal

Oral sedation: It is the most accepted route for administration of any drug. Absorption through this route is not consistent and depends upon the conditions of the stomach. Reversal is also not possible and recovery time is prolonged as the drug is slowly metabolized.

Intramucular sedation: This route can be used in children who refuse taking drugs through oral route. Even in this route it is not possible to reverse the actions once the drug is injected. The site of injection in children is the upper outer quadrant of the gluteal region into the gluteus maximus muscle.

Submucosal sedation: It involves deposition of the drug beneath the mucosa. Onset of action is fast compared to the intramuscular route. Caution should be exercised in selecting a drug as it should not irritate the delicate mucosa.

Intravenous sedation: This route is not used regularly and should be practiced only by persons qualified to provide intravenous sedation. Onset of action is about 20-25 seconds. The patient has to be closely monitored.

Agents Commonly used for Sedation

1. *Gases*—example are nitrous oxide and oxygen combination
2. *Antihistamines*—hydroxyzine, promethazine, diphenhydramine
3. *Benzodiazepines*—diazepam, midazolam



4. *Barbiturates*—short acting such as seconal, pentobarbital
5. Chloral hydrate
6. *Narcotics*—meperidine, fentanyl

Nitrous Oxide - (N_2O)

It is the common inhalation agent used. It is a colourless, odourless, heavier than air, non-inflammable gas. It is absorbed quickly from the alveoli of the lungs and is physically dissolved in the blood with no chemical combination anywhere in the body. It is carried in the serum portion of the blood and excreted through lungs without any biotransformation. Small amount may be found in the body fluids and intestinal gas.

Actions (pharmacodynamics) of Nitrous Oxide

- ❑ Creates an altered state of awareness without impaired motor function and is a central nervous system depressant
- ❑ Increases the respiratory rate and decreases the tidal volume
- ❑ Cardiac output is decreased and peripheral vascular resistance is increased (important in cardiac patients)
- ❑ Rapid induction and reversal may induce vomiting

Absorption, metabolism and excretion

- Enters blood by crossing pulmonary epithelium and depends upon the concentration gradient
- During early phases of administration – brain, heart, liver and kidney absorb the major portion of nitrous oxide from blood
- Expired through lungs.

Requirements of the equipment used for the induction of nitrous oxide

1. Should have a continuous flow design with flow metres capable of accurate regulation
2. Automatic shut down if oxygen level falls < 20%
3. Flush level for easy and immediate flushing of the system with 100% oxygen
4. Can be either mobile units or operating from a central supply
5. Good and efficient scavenger system
6. Nasal hood should be of adequate size – for the adults and children.

Techniques

Very important in the procedure for affective conscious sedation is the acceptance of the nose piece by the patient. If the patient exhibits resistance then this method is not advised for such children. This requires explanation at the youngster's level of comprehension, a slow approach and behavior shaping with positive reinforcement throughout.

Two techniques have been described-

- A. *Slow induction technique* – Described by Langa (1968)
- B. *Rapid induction or 'surge' technique* – Described by Sorenson and Roth (1973) and Simon and Vogelsberg (1975)

Slow induction technique

- Total liter flow rate/ minutes of gases should be established first with 100% oxygen. Adults – 5-7 lts/min and children of 3-4 years – 3 lts/min
- The child should be introduced to the operatory using tell-show-do approach
- After stabilization of the nose piece, 100% oxygen is delivered for 3-5 minutes
- Then the nitrous oxide level is increased to 30-35% for 3-5 minutes (induction period)
- During this induction period, the dentist continuously communicates with the child to promote relaxation and reinforce cooperative behavior
- If the child is older, he can be asked for the physical changes like tingling sensation in the finger and toe.
- The eyes will take a distant gaze with sagging of eyelids
- Most dentists will prefer to increase the level of nitrous oxide to 50% for 3-5 minutes to provide the maximum effect for the administration of LA
- Concentration of >50% are contraindicated in dental practice. After local anesthesia the concentration can be brought down to 30-35%
- After the treatment – inhalation of 100% oxygen for not less than 5 minutes should be continued. This allows diffusion of nitrogen from the venous blood into the alveolus, which is then exhaled as nitrous oxide through respiratory tract and also allows



the patient to return to pretreatment activities without any incident. Inadequate oxygenation may produce nausea, light headedness or dizziness.

- After the procedure, the child should be kept in supine position or on his side to maintain airway patency. Upon arriving home the child should be placed on his side and observed carefully for the 1st hour. If he wishes to sleep, he can be allowed to do so.

Rapid induction technique

- Initiation is done by administering equal parts of nitrous oxide and oxygen for 10-15 minutes.
- This is followed by maintenance phase where the nitrous oxide is reduced by half for 40 minutes.
- Withdrawal is by administering oxygen only.
- Oxygen is used to prevent anoxia, which is produced if nitrous oxide is used alone.

Difference Between Conscious Sedation and General Anesthesia

Conscious sedation	General anesthesia
Treatment done in several appointments	All procedures done in one appointment
Used in cooperative but anxious and fearful patient	Used in very uncooperative patient
Need for basic preoperative investigation	Requires thorough investigation and anesthetists approval for fitness
Patient is conscious during the procedure	Patient is unconscious
Reflexes and airway maintained	Reflexes are lost and ventilation required
Patient need not be starving before procedure, but lighter stomach is preferred	Requires to be in empty stomach at least 6 hours before the procedure

Patient Symptoms Obtained At Various Nitrous Oxide Levels

Nitrous oxide	Symptoms
10-20%	Tingling feeling (paresthesia), sensation of warmth
20-40%	Numbness of the extremities, floating sensation, auditory changes (distant humming noise), analgesia and euphoria
40-60%	Dreaming, laughing or giddiness, sweating nausea and vomiting, uncoordinated movement, loss of eyelid reflex

Common problems associated with nitrous oxide

1. *Sleep*—Patient may go into sleep during the procedure and frequent arousal or communication is required
2. *Airway obstruction*—frequent repositioning of the head is needed to hyper extend the mandible so that the tongue is brought forward
3. *Vomiting*, this can be prevented by
 - using minimum effective concentration
 - avoiding prolonged procedure
 - empty stomach inhalation
 - slow return to upright position
 - aspiration is unlikely – so just ask the patient to vomit in a chairside emesis basin if there is vomiting.
4. *Diffusion hypoxia*—Since nitrous oxide has a lower blood solubility, it rapidly diffuses into alveoli and dilutes the alveoli air causing a fall in the partial pressure of oxygen in alveoli. 100% oxygen for 10 minutes
5. Increased nitrous oxide concentration should be avoided. Pressure will be created in the air filled body cavities especially in the middle ear.

Other Drugs used for Sedation

1. *Hydroxyzine*
 - Rapidly absorbed from the gastrointestinal tract.
 - Clinical effect seen in 15 to 30 minutes, with peak levels at 2 hours.
 - Excreted by the liver with a mean half-life of 3 hours.
 - Administration is preferably by the oral route.
 - Intramuscular injections must be deep in a large muscle mass. Care must be exercised in the small child. It should not be injected subcutaneously or intravenously because of potential tissue necrosis and hemolysis.
 - *Adverse reactions*: extreme drowsiness, dry mouth, and hypersensitivity
 - *Dosage*: Oral-0.6 mg/kg
IM-1.1 mg/kg
2. *Promethazine (Phenergan)*
 - Well-absorbed after oral ingestion.
 - Onset is within 15 to 60 minutes, with a peak at 1 to 2 hours and a duration of 4 to 6 hours.



- Metabolized by the liver.
- Any phenothiazine should be used with caution in children with a history of asthma, sleep apnea, or a family history of sudden infant death syndrome (SIDS). Phenothiazines lower the seizure threshold and should be avoided in seizure-prone patients. It is not routinely used.
- Interactions: potentiates other CNS depressants
- Adverse reactions: dry mouth, blurred vision, thickening of bronchial secretions, mild hypotension, extrapyramidal effects
- Dosage: Oral/IM-0.5 to 1.1 mg/kg

SC-not recommended

Maximum recommended single dose is 25 mg

3. Diphenhydramine (Benadryl)

- Rapidly absorbed through the gastrointestinal tract,
- Maximum effect in 1st hour and a duration of 4 to 6 hours.
- Metabolized by the liver and completely excreted in 24 hours.
- Produces a mild sedative effect but has additive effects with other CNS depressants.
- Adverse reactions: disturbed coordination, epigastric distress, and thickening of bronchial secretions
- Dosage: Oral, IM, or IV-1.0 to 1.5 mg/kg.

Maximum single dose is 50 mg

4. Diazepam (Valium)

- It is lipid soluble and water insoluble.
- It is rapidly absorbed from the gastrointestinal tract
- Peak levels reaches at 2 hours.
- Biotransformation of the drug occurs quite slowly, with a half-life of 20 to 50 hours. The drug has three active metabolites, and these are more anxiolytic than sedative.
- Diazepam can be administered orally, rectally or parenterally. If the intravenous route is to be utilized, a large vein and slow administration is recommended because of the drug's propensity to cause irritation of the vein, with resultant thrombophlebitis. Additionally, rapid administration may result in apnea.

- Ataxia and prolonged CNS effects are the only common adverse reactions that can be anticipated when diazepam is used for conscious sedation.
- Dosage: Oral or rectal-0.2 to 0.5 mg/kg.

IV-0.25 mg/kg

Maximum single dose is 10 mg

Rebound effect of diazepam

After intravenous administration of diazepam, it is redistributed within 30 to 45 minutes, and the patient seems to be not sedated though free from anxiety. The patient should not be considered recovered from the drug. It has simply been redistributed. Later the stored drug can be redistributed to the CNS by a fatty meal some time later and the patient will suddenly be resedated. This is referred to as the 'Rebound effect'.

5. Midazolam

- The parenteral form of this benzodiazepine is similar to diazepam but with twice the potency.
- Significant advantage of midazolam over diazepam is its high water solubility. Consequently, the possibility of thrombophlebitis is reduced to a minimum.
- After intravenous administration, sedation occurs in 3 to 5 minutes. Recovery occurs in 2 hours but is variable and may require up to 6 hours for complete return to baseline values. There is no rebound phenomenon from metabolites.
- Midazolam can also be effectively given intramuscularly.
- Recently the oral form has become available and holds great promise for pediatric conscious sedation. The drug is highly lipophilic, providing for rapid absorption from the gastrointestinal tract as well as rapid entry into brain tissue.
- Elimination is also rapid, giving a shorter duration of activity. The elimination half-life is 10 times less than that of diazepam.
- Midazolam may produce respiratory depression with higher doses.
- Dosage: Oral-0.25 to 1 mg/kg to a maximum single dose of 20 mg
IM -0.1 to 0.15 mg/kg to a maximum dose of 10 mg.



6. Barbiturates

Barbiturates can produce all levels of CNS depression, ranging from mild sedation to general anesthesia and deep coma.

The short-acting barbiturates, seconal and pentobarbital were previously recommended for pediatric oral conscious sedation, but it is not being used now due to the availability of sedative/hypnotics with fewer adverse effects.

7. Chloral hydrate

Chloral hydrate is an extremely well-known and widely used drug for pediatric sedation.

- It has an onset of action of 15 to 30 minutes when given orally.
- The peak effect may not occur, however, for an hour or more.
- It has a duration of action between 4 and 8 hours and a half-life of 8 to 11 hours as a result of active metabolites.
- The primary metabolite of chloral hydrate is trichloroethanol (TCE), which is responsible for most of the CNS effects that occur.
- Chloral hydrate is irritating to gastric mucosa and unless diluted in a flavored vehicle will frequently cause nausea and vomiting.
- Children will often enter a period of excitement and irritability before becoming sedated.
- The drug causes prolonged drowsiness or sleep and respiratory depression. In large doses it will produce general anesthesia.
- Large doses additionally depress the myocardium and can produce arrhythmias and thus should be avoided in patients with cardiac disease.
- The lethal dose of chloral hydrate is stated to be 10 gm in adults, yet ingestion of 4 gm has caused death. Because the drug dose does not reliably produce sedation of a degree to permit operative procedures at lower doses, the tendency is to push the dosage higher to achieve the necessary sedation. With such a wide range of reported toxicity this choice may be unwise for many pediatric patients. It is recommended that young children receive not more than 1 gm. As a total dose. Risks are increased when chloral hydrate is combined with nitrous

oxide, narcotics, or local anesthetic agents. At higher doses and in combinations, loss of a patent airway is a common problem

- Dosage: must be individualized for each patient and is about 25 to 50 mg/kg to maximum of 1 gm.

8. Meperidine

- It is a synthetic opiate agonist. It is very water soluble but is incompatible with many other drugs in solution.
- Meperidine may be administered orally or by subcutaneous, intramuscular, or intravenous injection.
- It is least effective by mouth. It is very bitter and requires masking by a flavoring agent.
- Peak effect will occur in 1 hour and last about 4 hours. Parenteral routes shorten the time of onset and duration.
- High doses lead to an accumulation of normeperidine, a primary metabolite of meperidine, resulting in seizures. Meperidine should be used with extreme caution in patients with hepatic or renal disease and history of seizures.
- Dosage: Oral, subcutaneous, or IM-1 to 2.2 mg/kg, not to exceed 100 mg.

9. Fentanyl

- It is a very potent narcotic analgesic.
- A dose of 0.1 mg is approximately equivalent to 10 mg of morphine or 75 mg of meperidine.
- Fentanyl has a rapid onset, and after a submucosal or intramuscular injection the onset will occur in 7 to 15 minutes, with duration of action up to 1 to 2 hours.
- The drug is metabolized by the liver and excreted in the urine.
- Respiratory depression is the same as with other narcotics.
- In higher doses administered rapidly by vein, rigidity of skeletal muscle has been reported. This effect can be reversed by naloxone along with a skeletal muscle relaxant. Bradycardia also has been reported and atropine can be used to normalize heart rate.



- Fentanyl can be administered by the intramuscular, intravenous, or submucosal route.
- It is not recommended for use in children under 2 years of age.
- Dosage: 0.002 to 0.004 mg/kg

Chloral hydrate: It is the commonly used premedication

- It is an hypnotic that stimulates sleep at the cortical level, with no loss of reflexes.
- It is contraindicated in patients with marked hepatic or renal impairment, children receiving anticoagulant therapy.
- Dosage: 500 – 750 mg. for children aged 2-4 years.
- Ill effects: Nausea and vomiting

General Anesthesia

General anesthesia is preferred in children where behavior modification and conscious sedation have failed to improve the behavior.

Patient Indicated For Treatment Under General Anesthesia

1. Patients with serious medical problems who may be compromised and pose a serious medical or anesthesia risk in a nonhospitalized environment
2. Patients requiring complex or extensive dental care that can be accomplished more safely and conveniently with a multidisciplinary team of health care professionals
3. Patients who are not able to cooperate in dental clinic due to their handicapping conditions or disorders
4. Very young children who do not understand or rationalize and hence unable to cooperate in normal outpatient setting.
5. Children who have to undergo hospitalization and treatment under general anesthesia for reasons other than dental problems. Dental treatment can be simultaneously done in the operation theatre under general anesthesia.

Requirements of hospital set up for dental treatment:

1. An well equipped dental unit.
2. Experience, understanding and cooperative hospital staff.
3. Availability of adequate operating room time and patient beds.

4. Readily available pediatrician.
5. Close proximity to the dentist's private office.

Steps in Hospital Procedures

Step 1: Initial Examination and parent discussion

At the time of the initial dental appointment, a complete examination is performed and a detailed treatment plan is made. The treatment plan is discussed with the parents. Parents are informed about the need to perform the treatment under general anesthesia, associated risks and expenses.

Steps 2: Consultations

Medical clearance for performing dental treatment under general anesthesia should be obtained after discussion with the child's physician.

Step 3: Patient Admittance

Routinely treatment is performed in the morning and the patient can be admitted to the hospital the previous day evening. A consent form for anesthesia and dental procedure should be signed by the parents or guardian.

Step 4: Preoperative Procedures

Personal and medical record entry in the case sheet should be verified. Review nursing notes in the chart. Check to ensure that the patient's medical history and physical examination has been performed by the child's physician and recorded in the case sheet.

Step 5: Preoperative Preparation

All the equipment available in the hospital should be checked (Fig. 8.12). Any instruments or materials not provided or available for performing dental procedure must be brought by the dental team. All the instruments must be sterilized. Experienced dental surgery assistant should be present for assistance.

On the day of the dental operation the dentist and his team should arrive at the hospital at least 1 hour before the scheduled dental operation. All the personnel should change their clothing and wear operator's gown, gloves, shoe covers or special shoes provided inside the premises, head cover and surgical mask (Fig. 8.13)

The instruments and materials should be prearranged (Fig. 8.14A and B) on a trolley.



Fig. 8.12: Operation table, Boyle's apparatus and other necessary equipments in the Operation theatre



Fig. 8.13: Attire of the operating persons in the operation theatre



A



B

Figs 8.14A and B: Instruments and material should be arranged neatly on a trolley to be readily available

Step 6: Anesthesia Induction

The patient will be premedicated and may or may not be able to converse.

After the anesthesiologist are ready with the monitoring devices (Figs 8.15A to C) and intravenous route, induction begins. In younger children, induction may begin with a low percentage of anesthetic gases. In older children, a barbiturate may be used. Intravenous succinylcholine or a similar drug is administered to assist in the induction of the patient.

The dentist should request nasal intubation (Fig. 8.16) instead of oral intubation (Fig. 8.17) for maintenance of the anesthetic state. When the anesthesiologist has completed the placement of the nasal tube, the tube should be taped in place on the child's face and nose. Some anesthesiologists will place an ophthalmic ointment in the eyes and then tape them shut to prevent conjunctivitis and entry of foreign bodies in the eyes.



A



B



C

Figs 8.15A to C: Monitoring Devices; A. Pulse Oximeter;
B. Cardiac leads

Step 7: Dental treatment Procedure

The dental surgery equipment is brought into place. A throat pack is a must and is carefully placed. The patient's lips are lubricated by petroleum jelly to avoid drying.



Fig. 8.16: Nasal Intubation

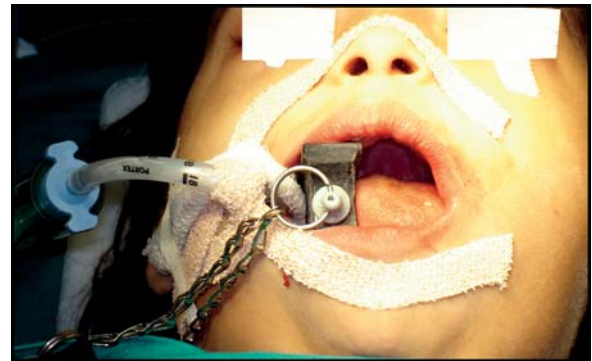


Fig. 8.17: Oral Intubation. It may not be possible for nasal intubation in children less than 5 years

Bite blocks (Fig. 8.18) should be used for mouth opening.

While selecting the type of treatment to be rendered to the patient following points should be remembered:

- Any two or more surfaces of caries should be restored with a stainless steel crown.
- Any incipient interproximal or developmental precarious lesions should be restored.
- There should be no heroic pulp therapy done where prognosis is a doubt.
- Indirect pulp capping and direct pulp capping procedures should be avoided
- When there is doubt as to pulpal status and the treatment choice perform the more radical one. For example when there is a doubt regarding the health of the radicular pulp perform pulpectomy instead of pulpotomy.



Fig. 8.18: Rubber bite blocks is used to restrain the mouth

The anesthesiologist must be informed as to the anticipated finishing time because the amount of gaseous anesthesia can be reduced, and the patient will receive a high percentage of oxygen.

Rinse and thoroughly aspirate the mouth. Gently remove the throat pack and inspect the area for any debris. The anesthesiologist will use an aspirating tube to clear the nasal area, pharynx, and throat of debris and accumulated fluids.

Step 8: Postoperative Procedures

Do not leave the operating room until the patient has recovered and reacting. Reassurance to the patient during this period is often very helpful for recovery.

The operative summary and postoperative instructions are entered in the patient's case chart.

Step 9: Discharge and Follow-up Care

The patient's progress is reviewed and the patient is discharged. Discharge orders should be written after checking the nurse's notes and the patient has been evaluated by the attending anesthesiologist and physician.

The discharge summary should include:

1. Date of admission
2. Diagnosis
3. Procedure performed
4. Complications if any

5. Discharge status
6. Date of discharge
7. Disposition
8. Follow-up
9. Dentist's signature

Agent used for General Anesthesia

1. Halothane
2. Enflurane
3. Isoflurane
4. Sevoflurane
5. Desflurane

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Chapter 9



Preventive and Interceptive Orthodontics

1. Introduction
2. Definition
3. Aims of Preventive and Interceptive Orthodontics
4. Preventive Orthodontics
5. Interceptive Orthodontics
6. Anterior Cross Bite Correction
7. Preorthodontic Trainer
8. Space Management and Space Maintainers
9. Soldering Procedure



INTRODUCTION

Pedodontists are in an advantageous position in identifying a developing malocclusion, thus reducing or eliminating the need for corrective therapy in later adult life. Preventive and interceptive orthodontics are the two phases of orthodontics that is best practised in a developing stage.

DEFINITION

Preventive orthodontics according to Graber “is the action taken to preserve the integrity of what appears to be a normal occlusion at a specific time.” The procedures that are done are aimed to prevent the development of any risk factors that would probably cause malocclusion. Hence, preventive orthodontics are undertaken before the actual malocclusion develops, thus preventing the development of future malocclusion.

Interceptive orthodontics “is employed to recognize and eliminate potential irregularities and malpositions in the developing dentofacial complex.”

Difference between preventing and intercepting depends on the timing of the service that is rendered.

A child should be seen by his dentist as early as 2½ years and should include thorough clinical examination with diagnostic records like the X-rays, study models and photographs.

By the time the child is 5 yrs the child should be placed on a definite schedule for obtaining longitudinal records.

Indication of Future Malocclusion

- Deviation from the normal growth and development
- Disharmony between the skeletal, muscle and dental structures, as in oral habits
- Premature loss of deciduous teeth
- Extensive carious lesions, especially involving the proximal sides.

AIMS OF PREVENTIVE AND INTERCEPTIVE ORTHODONTICS

The aim is to achieve:

1. Permanent dentition with all teeth in good alignment and contacts anatomically compatible with a healthy periodontium.

2. Dental arches well related in all 3 planes of space with an optimal intercuspation that is substantially identical in both centric occlusion and centric relation.
3. Dentition in harmony with esthetics in frontal and profile appearance.
4. Stability between skeletal, dental and muscular components.

PREVENTIVE ORTHODONTICS

It involves taking radiographs and use of study models to identify any risk factors that may lead to malocclusion in the later life. It also involves counseling parents regarding these risk factors and other needs of the child so as to achieve good oral health.

Role of Radiographs in Preventive Orthodontics

To identify:

- Congenital missing teeth
- Supernumerary tooth
- Deviation in eruptive and resorptive patterns
- Caries and other pathology.

Role of Study Models in Preventive Orthodontics

- As permanent records
- For measurement of arch length and arch width
- To estimate space adequacy
- To study growth changes through serial study casts.

Prenatal Advice to Mother as a Part of Preventive Orthodontics

- Regarding healthy diet and nutrition that will aid in normal growth and development of the fetus
- Proper nursing technique which will influence the functional and psychological development of the child
- Relation of mother's health and the tooth development of the child.

Postnatal Care as a Part of Preventive Orthodontics

- Care of the deciduous teeth- such as early detection of caries, oral hygiene instructions, fluoride therapy and space maintenance



- Removal of supernumerary tooth, as it can cause impaction or midline diastema
- Removal of retained deciduous tooth, as it may deviate the path of eruption of the successor.
- Removal of ankylosed tooth, if the successor is present
- Correction of premature contact
- Oral habit correction
- Use of mouth protector
- Correction of abnormal frenal attachment.

INTERCEPTIVE ORTHODONTICS

It includes all procedures undertaken to reduce the severity of malocclusion so that normal occlusion can progress in future. It includes:

- Serial extraction
- Occlusal equilibration—like removal of premature contact and correction of minor malocclusion
- Control of abnormal habits
- Muscle exercise
- Frenum correction
- Removal of supernumerary teeth, ankylosed teeth or any soft or hard tissue that form barriers for eruption of permanent teeth
- Space regaining following premature loss of deciduous tooth/teeth leading to space closure.

Problems Encountered in Primary and Mixed Dentition Periods and the Procedures to Correct Them

Anterior Cross Bite

- Can be due to true Class III malocclusion, pseudo Class III malocclusion or due to acquired muscular reflex pattern
- Simple shift of one or more maxillary anterior teeth may occur due to abnormal inclination of teeth. This may be due to abnormal eruptive patterns caused by prolonged retention of deciduous teeth.
- If not corrected may lead to skeletal malocclusion and require corrective orthodontic treatment later. Correction is done to prevent TMJ disturbance and allow for normal growth of maxilla.

Appliances used for correction of anterior cross bite

A. Tongue blade

- B. Inclined plane
- C. Composite plane
- D. Reverse stainless steel crown
- E. Hawley's appliance with Z' spring
- F. Use of screws embedded in acrylic

Tongue blade therapy (Fig 9.1): It is used while the incisors are still erupting and when single tooth is in cross bite. The tongue blade is inserted at an angle between the teeth and the patient is asked to bite firmly for 5 seconds followed by rest. This is repeated 25 times for 3 times a day. It is discontinued if unsuccessful even after 2 weeks. The main disadvantage with this is that the patient cooperation is required.



Fig. 9.1: Tongue blade in position

Inclined plane (Figs 9.2 and 9.3): It is used while more than one tooth is involved. It is made of acrylic and produces a forward sliding motion of the maxillary incisors on closure. This appliance should not be worn for more than 4 weeks as it may cause supra eruption of the posterior teeth, leading to anterior open bite.

Composite plane: An inclined plane is fabricated on the lower incisors with composite instead of acrylic.

Reverse stainless steel crown (Fig. 9.4): It is used when there is a single tooth cross bite. The crown is cemented backward on the maxillary incisor. This forces the upper tooth to move out towards the lip as the child bites down on the lower teeth. The cross bite can be corrected in 2-4 weeks.

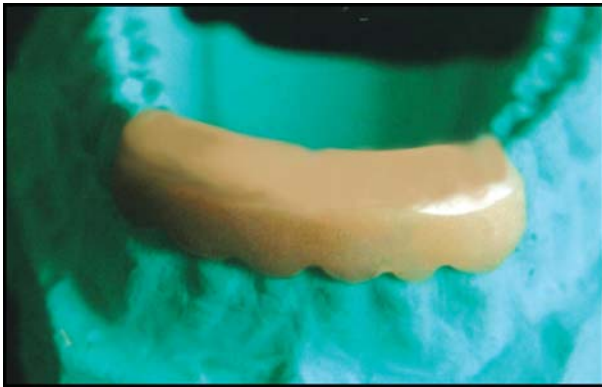


Fig. 9.2: Inclined plane for the correction of anterior cross bite

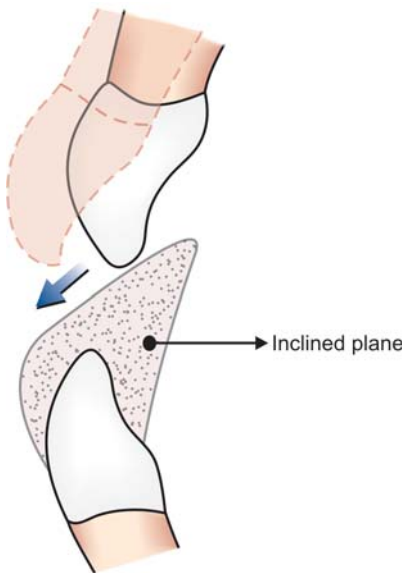


Fig. 9.3: Diagrammatic representation of the inclined plane showing 45° slope, over which the upper incisors slide in a downward and forward direction

Maxillary appliances with Z 'springs and posterior bite plane (Fig. 9.5): It is used when many teeth are in cross bite along with posterior bite plane. The posterior bite plane is used to keep the anterior teeth out of occlusion so that the incisors can jump the bite.

Screws embedded in acrylic (Fig. 9.6): The appliance consists of jackscrew inserted in a palatal acrylic

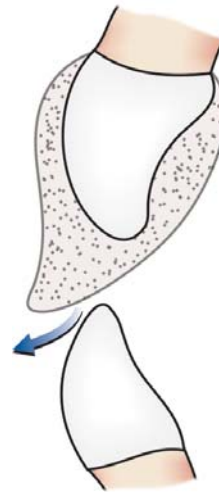


Fig. 9.4: Reverse stainless steel crown cemented on the upper incisor for the correction of anterior cross bite



A



B

Figs 9.5A and B: Cross bite correction with Z'springs; A: Pre-treatment; B: Post-treatment

appliance. It is a removable, slow expansion device. Every turn (1/4) opens the midline by 0.25 mm. and is activated every week. A total of 4.5 mm. expansion can be achieved. It is activated by a small pin. The same appliance can be used as retainer for 3-6 months. Since it is a removal appliance oral hygiene maintenance is easier.

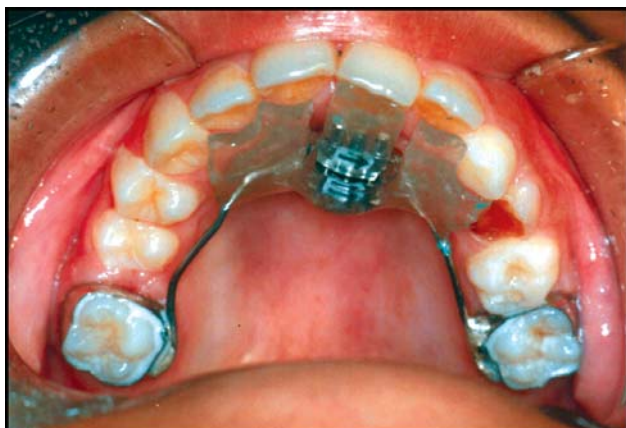


Fig. 9.6: Appliance with screw for the correction of cross bite

Posterior Cross Bite

Posterior crossbite can be bilateral due to constriction of the arch or unilateral due to tipping of individual teeth or it can be actually bilateral but the patient may deviate the mandible to one side to attain maximum intercuspation. If left untreated it may bring about compensatory structural changes of the mandible and sometimes in the condyle.

Appliance used for correction of posterior cross bite are:

Cross elastics: Bands with hooks are placed on the palatal aspect of upper tooth and buccal aspect of lower tooth that are in crossbite. Orthodontic elastics are engaged in the hooks and worn for 24 hours/day. Correction may take 3 weeks to 3 months. More change will be reflected in the position of the maxillary molars due to cancellous nature of the maxillary alveolar bone.

Jack screw: The appliance design is similar to the one used for correction of anterior cross bite, but the position of the screw is more posterior in the midline. There are chances of dentoalveolar tipping of posterior teeth and requires patient cooperation and constant evaluation.

Fixed porter arch or quad helix appliance: It is a fixed device with molar bands cemented of the first permanent molar. The disadvantage is that it is difficult to fabricate and adjusting is done without removal from the mouth.

It is adjusted once a month and requires 3 to 4 months for correction.

Rapid palatal expansion appliance: It is a fixed appliance and is activated twice daily. It is worn for 2 months after the correction for retention. There is splitting of mid palatal suture producing orthopedic increase in maxillary width reflected by the formation of midline diastema.

Diastema

Etiology of diastema can be due to ugly duckling stage, large frenum, mesiodens, habits, peg shaped lateral incisors, loss of tooth resulting in drift, discrepancies between tooth size and jaw size. Management is aimed at removal of the etiological factor. Removal or fixed appliance can be used to correct the diastema. Removal appliance consists of finger springs or a split labial bow. Fixed appliance utilizes elastics engaged on to the brackets bonded on the labial surface of the central incisors.

Deep Bite

Usually seen due to infra eruption of posterior teeth and overclosure of mandible. Also seen in TMJ dysplasias due to imbalance caused by temporalis and lateral pterygoid. Anterior bite plane can be given that allows eruption of premolars and relieves the muscle spasm.

APPLIANCE USED TO INTERCEPT DEVELOPING SKELETAL MALOCCLUSION

Preorthodontic Jaw Trainer

The flexibility as well as inherent memory effects of silicone which is a non-thermoplastic polyurethane material is used to fabricate preorthodontic jaw trainer. This appliance brings about tooth guidance and as well as functional effects.

Design of Preorthodontic Jaw Trainer (Fig. 9.7)

- The appliance is soft and shaped in the form of the normal parabolic shape of the dental arches.



- It has channels for the maxillary and mandibular teeth.
- The labial/buccal screen has premolded condensations of the material, which act as labial bow. This allows the irregular teeth to get aligned and the tooth channels further guide the teeth into the normal arch form.
- The oral screen like structure enveloping the teeth buccally/ labially help in treating the mouth breathing or thumb sucking habits. This allows for the child to shift from oral to nasal breathing, which in turn allows the nasal passages to develop and the palate to descend.
- The maxillary arch, therefore, tends to develop into a shallow and a U' shaped arch due to the parabolic shape of the appliance.
- Promotion of development of a U' shaped arch allows an increase in the inter-canine dimensions of the maxilla, which in turn allows an increase in the inter-canine dimensions of the mandible, thereby allowing resolution of mandibular anterior crowding.
- Small projections on the labial aspect of the oral screen like structure in the region relating to the mandibular anteriors, behaves as a lip bumper, thereby allowing a mandibular anterior arch to develop into a rounded one and thereby increasing arch perimeter.
- It also allows the perioral group of muscles to become normotonic thereby ensuring a lip seal.
- A tongue tag has also been incorporated in the maxillary palatal aspect, which is used to train aberrant tongue habits such as retained infantile or tongue thrust cases.

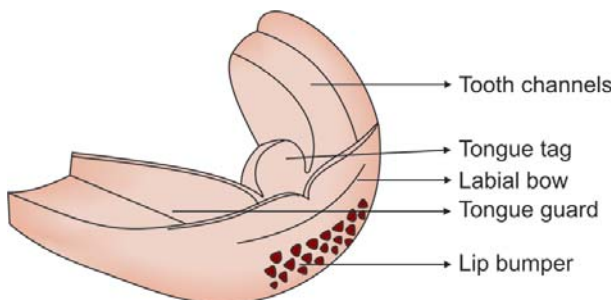


Fig. 9.7A: Parts of a preorthodontic trainer



Fig. 9.7B: Preorthodontic trainer in patients mouth

Method of Use

These are used in two phases:

1. The softer blue preorthodontic trainer is use first and allows for correction of aberrant muscle movements and mild tooth movements. This is generally worn for about 6 months.
2. It is followed by the firmer pink pre-orthodontic trainer, which exerts slightly greater forces for the alignment of teeth and has to be worn for about 12 months.

The Cad/Cam process has allowed the appliance to be developed in such a way that a single size is applicable to all the patients. The only adjustments required are in case of the distal aspects, which can be easily trimmed.

The appliance should be inserted for a minimum of one hour daily during the day and also be worn while sleeping. Initially, the appliance may fall out while sleeping at night, this would decrease over a couple of weeks and finally the appliance would not fall out in sleep, as the aberrant muscular forces become normal.

Initially it may be worn for at least one hour, so as to unlearn the old habits and learn the correct habits at the conscious levels. A clinical review once every month is important to review as well as motivate the child to wear the appliance. The appliance is kept clean by brushing the same with lukewarm soft soapy water everyday.

Indications of Preorthodontic Jaw Trainer

1. Mandibular anterior crowding
2. Class II division 1 and 2
3. Anterior open bite
4. Deep bite



5. Mild class III/ pseudo class III
6. Tongue thrusting, thumb sucking and mouth breathing habits.

Contraindications of Preorthodontic Jaw Trainer

1. Posterior cross bite
2. Severe class III
3. Complete nasal obstruction
4. Non-cooperative child/parent.

SPACE MANAGEMENT

Space management or maintenance is aimed at preserving the space required for the eruption and alignment of permanent dentition.

Premature loss of tooth is one of the most frequent etiological cause for space loss in children, other causes being interproximal caries, ectopic eruption of first permanent molars, delayed eruption, ankylosis of primary molars, disproportionate tooth size, etc.

Regardless of the cause, loss of space results in arch length reduction and loss of structural balance and functional efficiency.

Definitions

Space Maintenance

“Defined as the measures or procedures that are brought into use following premature loss of deciduous tooth/teeth, to prevent loss of space and improve arch development”.

Space Management

“It includes the measures that diagnose and prevent or intercept situations, so as to guide the development of dentition and occlusion”.

Changes following Premature Tooth Loss (Figs 9.8 and 9.9)

A tooth is maintained in its correct relationship in the dental arch as a result of the action of a series of forces.

Example: Second deciduous molar is held in correct relationship by

1. Mesial force exerted by the first permanent molar
2. Distal force exerted by the first deciduous molar
3. Tongue on lingual side
4. Cheek on buccal side
5. Alveolar process and periodontal tissue producing an upward force
6. Teeth in the opposing arch extending a downward force.

If one of the forces are removed or altered, changes in the relationship of adjacent teeth will occur and will result in drifting of teeth and development of space problems.

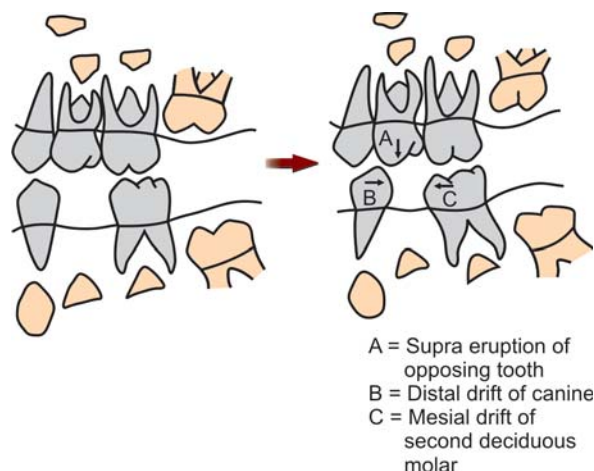


Fig. 9.8: Change occurring due to premature loss of lower first deciduous molar



Fig. 9.9: Closure of space following premature loss of second deciduous molar

**Etiology of Space Closure/Contributing Factors**

1. *Inclination of the long axis of permanent molars*—If two teeth contact each other in occlusion and each tooth is inclined in a mesial direction, there will be created a mesial component of force which will tend to tip these teeth further and will transmit a mesial force to the contacting adjacent tooth. This factor is more significant in permanent dentition than primary dentition because the later are more vertically positioned.
2. *Path of least resistance*—Teeth tend to move in the direction of the path of least resistance as created by loss of support following extraction of an adjacent tooth.
3. *Influence of buccal musculature*—The buccinator that wraps the posterior teeth may exert mesial force on posterior teeth.
4. *Effect of the position of the centre of rotation of the mandible*—Smyd (1955) pointed out that more the axis of mandibular rotation is lowered in respect to the occlusal plane, the less the amount of horizontal anterior thrust is transmitted to the teeth in occlusion.

Resulting Effects due to Premature Loss of Deciduous Teeth**Premature Loss of Anterior Teeth**

- Main concern is based on esthetics speech and function
- Space loss is rarely observed.

Premature Loss of First Deciduous Molar

- Effect depends on the stage of occlusal development
- If it is lost before the eruption of first permanent molar, strong eruptive forces of the erupting tooth will tip the second deciduous molar into the space required for the first premolar.
- Distal drifting of deciduous canine especially during active eruption of later incisor.

Premature Loss of Second Deciduous Molar

- Before eruption of the first permanent molar there is complete chance of permanent molar erupting

into the space due to loss of contact guidance causing impaction of second premolar

- After the eruption of the first permanent molar, it may drift into the space resulting in reduced arch perimeter.

Planning for Space Maintenance, Factors Involved**Time Lapse Since Loss**

Maximum closure occurs within the first 6 months after extraction. Therefore it is best to insert an appliance as soon as possible after extraction.

Dental Age of the Patient

It is a general rule that the teeth erupt when $\frac{3}{4}$ of the root is developed, regardless of the child's chronological age. Thus the length of the developing root of the succedaneous tooth gives an indication the time required for the tooth to erupt into the oral cavity. But experience tells us that the tooth can erupt even before less than half of the root has developed (Fig. 9.10).

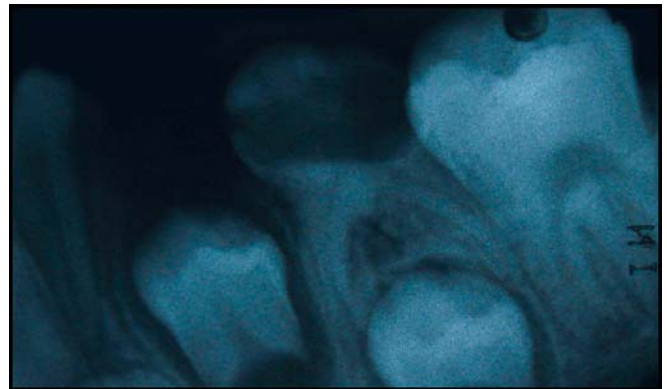
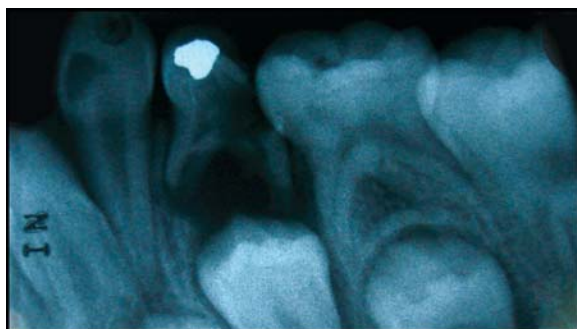


Fig. 9.10: Premolar seen erupting with less than half root formation

Amount of Bone Covering the Unerupted Tooth

Space maintainer is required when there is sufficient thickness of bone over the erupting succedaneous tooth. An erupting premolar usually requires 4-5 months to erupt or move through 1mm of bone as measured on a bite wing radiograph. When the bone covering is destroyed by infection (Figs 9.11A and B), eruption is accelerated and the teeth may even sometimes erupt with minimum of root formation.



A



B

Figs 9.11A and B: Since there is no bone over the erupting premolar in both the cases removal of the grossly decayed first deciduous molar will result in early eruption of the premolar

Sequence of Eruption of Teeth

The relationship of developing and erupting teeth adjacent to the space created has to be considered. For example, if the second deciduous molar is lost prematurely and second permanent molar is ahead of eruption of the second premolar, then there is possibility that second permanent molar will exert a strong force on the first permanent molar causing it to drift mesially and to occupy some of the space required by the second premolar.

Delayed Eruption of Permanent Tooth

Delay in eruption of permanent teeth may be due to impaction or deviation in the eruptive path. In such cases it is necessary to extract the primary teeth and construct a space maintainer and allow the permanent tooth to erupt and assure its normal position.

Congenital Absence of Permanent Tooth

In the absence of permanent tooth, the space created by loss of deciduous tooth can be maintained for

providing fixed prosthesis later. Other option is to allow space closure followed by required orthodontic repositioning later.

Presence of Oral Habits

Abnormal forces are exerted on the dental arches when associated with oral habits. So in such condition space maintainers has to be given immediately.

Existing Malocclusion

Arch length inadequacy and other forms of malocclusion particularly the Class II div 1 progressively become severe after the untimely loss of mandibular primary teeth. It is advised to maintain the space when there is existing malocclusion.

Space Analysis

It is done to estimate the space adequacy for the succedaneous tooth and to fairly predict how much space will be required for eruption and proper alignment in the dental arch.

Various analysis used for estimating space adequacy are:

Moyer's Mixed Dentition Analysis

The greatest mesiodistal width of the lower incisors are measured with Boley's gauge.

The amount of space needed for the alignment of the incisors is determined as follows- Boley's gauge is set to a value obtained by measuring the greatest mesiodistal width of the lower incisors. One point is placed at the midline and the other point lies along the dental arch on the right side. This point is marked on the cast and represents the point where the distal surface of the lateral incisor will be when aligned properly. The same thing is repeated on the left side of the arch. The space that is available for permanent canine and premolar is determined. The distance from the point marked on the cast, to the mesial surface of the permanent first molar is measured. This distance is the space available for eruption and alignment of the permanent canine, and two premolars. The combined width of mandibular canine and premolar is predicted with the aid of the probability chart (Fig. 9.12). The estimated canine and premolar size value is subtracted from the measured space, to obtain the extra space available.

**Maxilla:**

Width of Mandibular incisors	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0
95%	21.6	21.8	22.1	22.4	22.7	22.9	23.2	23.5	23.8	24.0	24.3	24.6
85%	21.0	21.3	21.5	21.8	22.1	22.4	22.6	22.9	22.2	23.5	23.7	24.0
75%	20.6	20.9	21.2	21.5	21.8	21.0	22.3	22.6	22.9	23.1	23.4	23.7
65%	20.4	20.6	20.9	21.2	21.5	21.8	22.0	22.3	22.6	22.8	22.1	23.4
50%	20.0	20.3	20.6	20.8	21.1	21.4	21.7	21.9	21.2	22.5	22.8	23.0
35%	19.6	19.9	20.2	20.5	20.8	20.0	21.3	21.6	21.9	22.1	22.4	22.7
25%	19.4	19.7	19.9	20.2	20.5	20.8	21.0	21.3	21.6	21.9	22.1	22.4
15%	19.0	19.3	19.6	19.9	20.2	20.4	20.7	20.0	20.3	21.5	21.8	22.1
5%	18.5	18.8	19.0	19.3	19.6	19.9	20.1	20.4	20.7	21.0	21.2	21.5

Mandible:

Width of Mandibular incisors	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0
95%	21.1	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.5	23.8	24.1	24.4
85%	20.5	20.8	21.1	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.5	23.8
75%	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1	23.4
65%	19.8	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1
50%	19.4	19.7	20.0	20.3	20.6	20.9	21.2	21.5	21.8	22.1	22.4	22.7
35%	19.0	19.3	19.6	19.9	20.2	20.5	20.8	21.1	21.4	21.7	22.0	22.3
25%	18.7	19.0	19.3	19.6	19.9	20.2	20.5	20.8	21.1	21.4	21.7	22.0
15%	18.4	18.7	19.0	19.3	19.6	19.8	20.1	20.4	20.7	21.0	21.3	21.6
5%	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0

Fig. 9.12: Probability chart used for Moyers mixed dentition analysis**Johnson and Tanaka's Analysis**

The sum of the width of the mandibular permanent incisors are measured and divided by 2. The estimated width of the maxillary and mandibular canine and premolar is calculated by adding 10.5 mm and 11.0 mm respectively to the half the sum of the width of the mandibular permanent incisors.

Radiographic Method

IOPA of the unerupted teeth and of the overlying primary teeth are taken. The enlargement ratio for each unerupted permanent tooth is computed by measuring the nearest erupted tooth first in the mouth and then in the radiograph.

The equation used is:

$$\frac{\text{Erupted tooth size in the mouth}}{\text{Erupted tooth size in X-ray}} \times \text{Unerupted tooth size in X-ray} = \text{correct tooth size}$$

Hixon and Oldfather

It involves summing of the maximum mesio-distal diameter of one permanent central incisor and one lateral incisor, with the diameter of the unerupted first and second bicuspid measured on the radiograph taken by the paralleling technique. The following prediction chart can be used:

Measured Value	Estimated Tooth Size
23 mm	18.4 mm
24 mm	19.0 mm
25 mm	19.7 mm
26 mm	20.3 mm
27 mm	21.0 mm
28 mm	21.6 mm
29 mm	22.3 mm
30 mm	22.9 mm



SPACE MAINTAINERS

Definition of Space Maintainers

Space maintainers are devices used to maintain or regain the space following the loss of deciduous tooth/ teeth.

Requirements of a Space Maintainer

1. Should maintain the desired proximal dimensions of the space created by the loss of tooth.
2. Should be functional.
3. Should not interfere with eruption of occluding teeth.
4. Should not interfere with the eruption of the replacing permanent teeth.
5. Should not interfere with speech, mastication or functional movement of mandible.
6. Should be simple and strong.
7. Should not impose excessive stress on adjacent tooth.
8. Easily cleansable.
9. Should not restrict the normal growth and function.

Indications of a Space Maintainer

1. Generally indicated when the forces acting upon the teeth are unbalanced and the space analysis indicates a possible space inadequacy for the succedaneous teeth, as when there is malocclusion or abnormal oral habits.
2. When a malocclusion exists that would be further compounded with loss of space.
3. Maximum closure occurs within the first 6 months after extraction. Therefore it is best to insert an appliance as soon as possible after extraction.
4. The teeth erupt when $\frac{3}{4}$ of the root is developed, regardless of the child's chronological age, it is advisable to place a space maintainer if the tooth is not ready for eruption.
5. An erupting premolar usually requires 4-5 months to erupt or move through 1mm. of bone as measured on a bite wing radiograph. This should be kept in mind while advising a space maintainer.
6. Disorder in the sequence of eruption of teeth.
7. Delayed or altered eruption of permanent tooth.
8. Congenital absence of permanent tooth.

Contraindication of a Space Maintainer

1. When there is no alveolar bone overlying the crown of erupting tooth and there is sufficient space for its eruption.
2. When space left is excess of the mesiodistal dimensions required for the eruption and space loss is not expected.
3. When there is gross space discrepancy requiring future extractions and orthodontic treatment.
4. When permanent succeeding tooth is congenitally absent and space closure is desired.

Classification of Space Maintainers

1. According to Raymond C Throw
 - a. Removable
 - b. Complete arch
 - Lingual arch
 - Extra-oral anchorage
 - c. Individual tooth space maintainer
2. According to Heinrichsen
 - a. Fixed space maintainer
 - Class I —Non-functional
 1. Bar type
 2. Loop type
 - Functional
 1. Pontic type
 2. Lingual arch type
 - Class II —Cantilever type
(distal shoe, band and loop)
 - b. Removable space maintainer
3. According to Hitchcock
 - a. Removable, fixed or semifixed
 - b. With bands or without bands
 - c. Functional or nonfunctional
 - d. Active or passive
 - e. Certain combinations of the above

Removable Space Maintainers (Figs 9.13 to 9.15)

They are space maintainers that can be removed and reinserted into the oral cavity by the patient. It can be functional or nonfunctional, and are bilateral most of the time.



Indications of Removable Space Maintainer

- Bilateral loss of posterior teeth in the mandibular arch before the eruption of the permanent incisors
- Missing anterior teeth where it is made functional
- Cases where patient cooperation is not a major criteria
- When space maintenance is required for a short period of time.

Contraindication of Removable Space Maintainer:

- Uncooperative patient
- Patients allergic to acrylic
- Epileptic patient

Advantage of Removable Space Maintainer

1. Easily cleansable – both the teeth and appliance.
2. Maintains vertical dimensions when made functional.
3. Can be used in combinations with other preventive or interceptive procedures, such as habit reminders.
4. Can be worn partime – allowing free blood circulation.
5. Can be made esthetically desirable.
6. Facilitates chewing and speaking when it is made functional.
7. Stimulates eruption of permanent teeth.
8. Keep the tongue in bounds.
9. Band construction is not necessary, thus reducing the chair side time.
10. Room may be made for erupting teeth without making a new appliance.

Disadvantage of Removable Space Maintainer

1. May be lost or broken.
2. Patient cooperation is important.
3. Restrict lateral growth of jaw if clasps are made incorrectly.
4. May irritate the soft tissues.

Types of Removable Space Maintainers:

1. Acrylic partial denture.
2. Complete denture – given when there is loss of all the teeth as in rampant caries or ectodermal dysplasias.
3. Removable distal shoe space maintainer. – Acts as acrylic immediate partial denture with distal shoe

extension into the alveolus. It is used when fixed distal shoe cannot be placed due to many missing teeth.

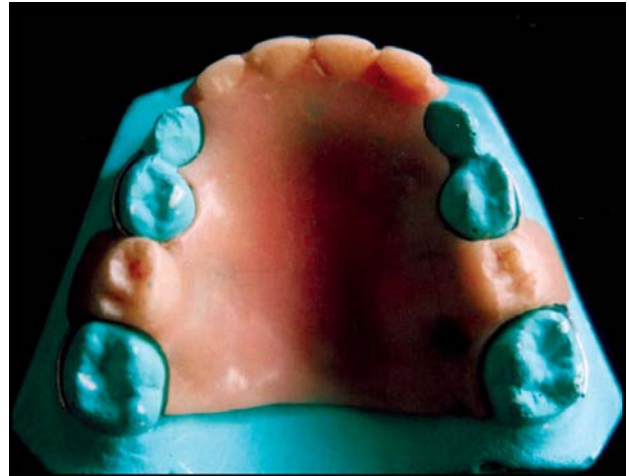


Fig. 9.13: Bilateral removable functional passive space maintainer



Fig.9.14: Bilateral removable nonfunctional passive space maintainer

Ideal Requirements of Removable Space Maintainer

1. It should restore or improve masticatory function.
2. It should restore and improve aesthetics and facial contours.
3. It should not interfere with normal growth of the dental arches.
4. Its bulk should not be an impediment to good speech.
5. Its design should allow the patient to insert and remove it easily.
6. The design should permit easy adjustment and alterations if required.



A



B

Figs 9.15A and B: Removable function space maintainer; A: Pre-treatment; B: Post-treatment

7. It should be cleaned easily.
8. Its design should require minimal or no preparation of the abutment teeth.
9. It should prevent over eruption of opposing teeth or drift of the adjacent teeth.
10. Be noncariogenic and non irritating to the supporting tissues.

Fixed Space Maintainer

They can be unilateral or bilateral, functional or nonfunctional, active or passive space maintainers that are designed to be cemented on to the tooth and thus cannot be removed by the patient.

Advantages of Fixed Space Maintainer

1. Patient cooperation is not required.
2. Jaw growth is not hampered.
3. Succedaneous teeth are free to erupt, depending on the design.
4. Masticatory function is restored if pontics are placed.

Disadvantages of Fixed Space Maintainer

1. Elaborate instrumentation is required.
2. Increased risk of caries.
3. Some designs interfere with eruption of successor, as with band and bar spacemaintainer.

Types of fixed space maintainer

1. Band and loop /crown and loop/band and bar space maintainer.
2. Lingual arch space maintainer.
3. Transpalatal bar space maintainer.
4. Nance palatal arch space maintainer.
5. Distal shoe space maintainers.

Band and loop space maintainers (Figs 9.16 and 9.17)

- They are unilateral, fixed, nonfunctional and passive space maintainer.

Indications of Band and Loop Space Maintainer

- Used when single tooth is missing in the posterior segment.
- It can also be given in bilateral posterior tooth loss, before the eruption of permanent anteriors in the mandible, where two band and loop space maintainer can be given instead of removable space maintainer.

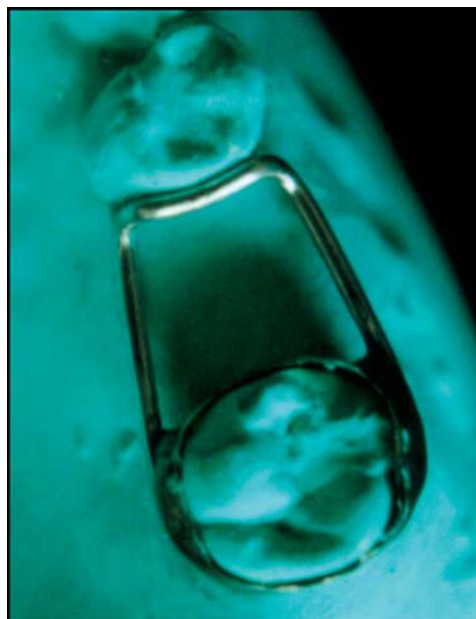


Fig. 9.16: Band and loop space maintainer



A



B

Figs 9.17A and B: Band and loop space maintainer; A: Pre-treatment first deciduous molar is grossly delayed is advised for extraction; B: Post-treatment

Contraindications of Band and Loop Space Maintainer

- High caries activity
- Marked space loss
- More than one adjoining teeth missing

Disadvantages of Band and Loop Space Maintainer:

- Nonfunctional
- Does not prevent continued supraeruption of opposing tooth
- Caries check is difficult
- Oral hygiene maintenance is difficult
- The loop may slip from the position and impinge on the gingiva. Occlusal rests given to the loop that rests on the occlusal surface of the mesial abutment tooth prevents this disadvantage.

Design of Band and Loop Space Maintainer

- It consists of a band fabricated from 0.005" steel band and a loop that extends from the band to the distal surface of the anterior abutment tooth. The loop is placed 1mm from the gingival surface. It should not be very wide that it may interfere with the cheek and tongue movements.
- Occlusal rest may be given on the loop that rests on the occlusal surface of the tooth, to prevent gingival tipping of the loop.

Construction of Band and Loop Space Maintainer

- Stainless steel band can be of two types, the preformed and custom made (Figs 9.18A and B). Preformed steel bands are available in different sizes and correct size has to be selected according to the size of the patients tooth. Custom made band are made by taking the required amount of band material from the spool and pinching them to form the band. Custom made bands are fabricated using various pliers (Figs 9.19A to C). They are adapted such that cervically it extends 1 mm subgingivally, Occlusally it should not extend upto the occlusal surface as it may interfere with the occlusion (Fig. 9.20).
- Impression of the arch is made with alginate and the band is removed from the tooth and placed in the impression (Fig. 9.21) with occlusal portion of the band facing towards the alginate and secured with wax or pins (Fig. 9.22). Cast is prepared with dental stone.
- Cast is obtained with the band secure on the tooth.
- Loop is prepared with 0.9 mm hard round stainless steel wire (Fig. 9.23). The loop extends from the middle of the band from its either side to reach the



distal surface of the anterior abutment tooth just below the contact point and above the gingival margin.

- The loop is then soldered to the band
- The joint is finished and polished using white stone and rubber wheel
- The band is cemented with glass ionomer cement, polycarboxylate or zinc phosphate cement. Glass ionomer cement is the material of choice.



A



B

Figs 9.18A and B: Band used for spacemaintainer; A: Preformed bands; B: Band material available in spool

Modifications of Band and Loop Space Maintainers

1. *Crown and loop space maintainer (Figs 9.24 to 9.25B):* Crown is replaced instead of a band. It is done when the abutment tooth requires the placement of crown for reasons such as gross caries, hypoplastic tooth or on a RCT treated tooth.
2. *Reverse crown/band and loop (Fig. 9.26):* If the distal abutment tooth cannot be band or crowned then the mesial abutment tooth is banded or crowned and loop is extended distally. This situation usually arises when the distal abutment tooth is not fully erupted.



A



B



C

Figs 9.19A to C: Pliers used for construction of band and loop space maintainer; A: Beak pliers; B: Band adaptor; C: Howe's plier (Straight and curved)

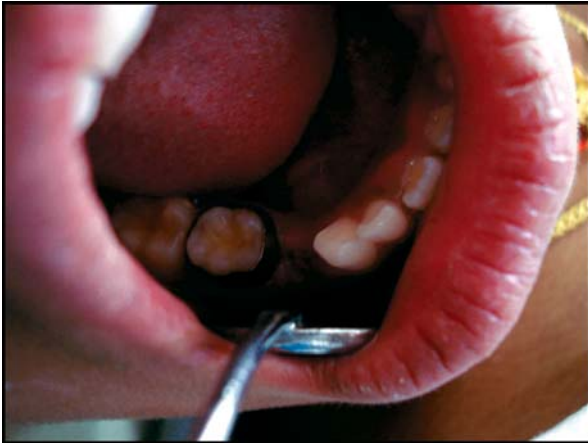


Fig. 9.20: Band adapted on the tooth



Fig. 9.23: Loop (Arrow) that is soldered to the band



Fig. 9.21: Band place in the impression, occlusal margin facing towards the impression

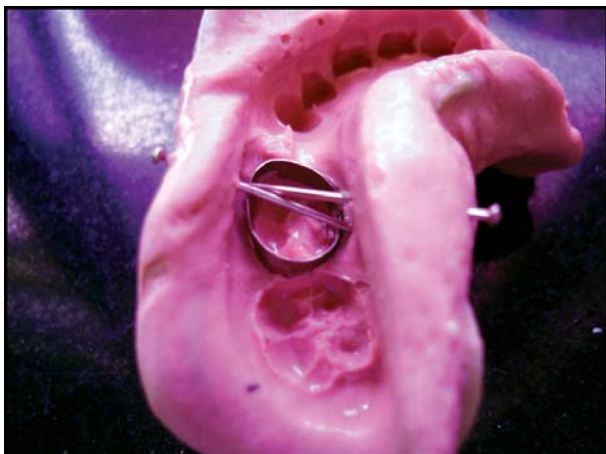
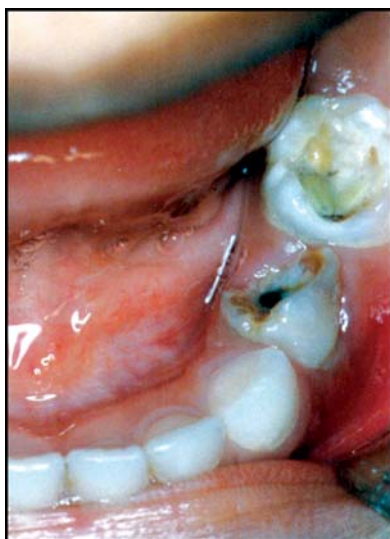


Fig. 9.22: Band secured in the impression with pins

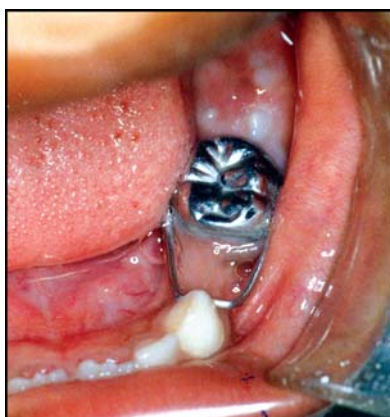
3. *Band and bar space maintainer* (Fig. 9.27): Instead of a cantilever design both the abutment teeth are banded and a bar placed in between them instead of a loop. It is sturdier but may interfere with the eruption of the permanent tooth as the bar is positioned on the centre of the ridge.
4. *Bonded space maintainer*: In this design no band or crown is placed. The loop that is similar to band and loop design is bonded with resin on the buccal and lingual surface of both the abutment teeth. The wire passes from one abutment to the other crossing the alveolar ridge.



Fig. 9.24: Crown and loop space maintainer



A



B

Figs 9.25A and B: Crown and loop space maintainer; A: Pre-treatment (First deciduous molar is indicated for extraction. Second deciduous molar is treated endodontically requiring placement of a crown); B: Post-treatment

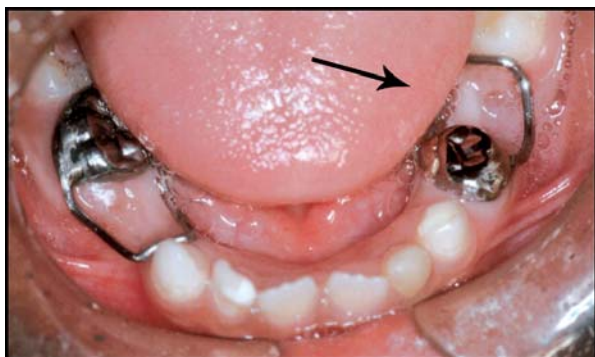


Fig. 9.26: Reverse crown and loop space maintainer on the right lower quadrant



Fig. 9.27: Band and bar space maintainer

Lingual Arch Space Maintainer (Fig. 9.28)

- It is a bilateral, fixed or semifixed, nonfunctional, passive space maintainer
- Indicated when there is bilateral loss of molars after the eruption of the permanent incisors in the lower arch. If the lingual arch is given before the eruption of the permanent lower incisors it may interfere with the eruption of the permanent incisors.
- The right and left first permanent molars are banded in the lower segment
- A 'U' shaped arch wire extends from the lingual surface of the molar bands to the lingual surface of the anterior teeth. They are placed above the cingulum of the lower incisors.
- It prevents the mesial movement of the posterior teeth and collapse of the anterior segment.



Fig. 9.28: Lingual arch space maintainer

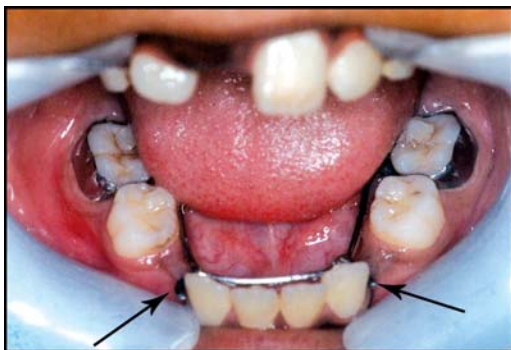


Modifications of lingual arch

- It can be made semifixed by welding a molar tube one on each of the bands on the lingual aspect. The arch wire is passed into the tube instead of soldering to the band. Part of the design (band) is fixed and the other part (arch wire) is removable.
- A 'U' loop can be incorporated in the arch wire to make it active, which aids in distalizing the molar and proclination of the collapsed incisors (Fig. 9.29A)
- Spurs can be added to the arch wire at the distal end of the canine to prevent distal collapse of the canine (Fig. 9.29B).
- Lingual arch is commonly given in the mandibular arch, but it can be given in the maxillary arch if there is no deep bite.



A



B

Figs 9.29A and B: Modification of lingual arch space maintainer; A: Lingual arch space maintainer with 'U' loop; B: Lingual arch space maintainer with canine spurs

Transpalatal Bar Space Maintainer (Fig. 9.30)

- It is a bilateral, fixed, passive and nonfunctional space maintainer
- The first permanent molars are banded
- The arch wire extends from the palatal aspect of the band to cross the midline transversely at right angles to the mid palatine raphe.
- It prevents the mesiolingual rotation of the permanent molar around the palatal root and prevents mesial movement of molars.
- It is used when there is unilateral loss of deciduous molars. If given in a bilateral missing case, then both the permanent molars can move mesially simultaneously.

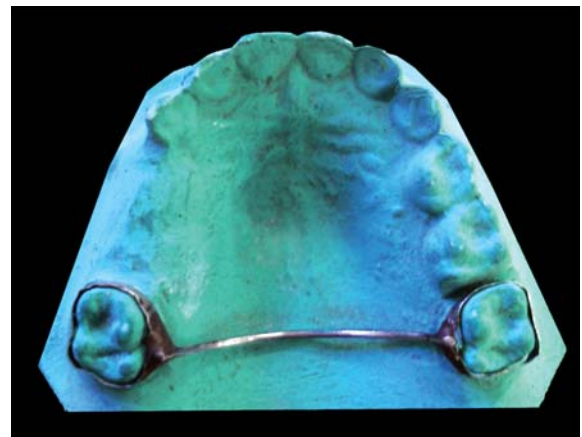


Fig. 9.30: Transpalatal bar

Nance Palatal Arch (Figs 9.31 and 9.32)

- It is a bilateral, fixed, passive and nonfunctional space maintainer
- The first permanent molars are banded
- The arched wire extends from the palatal surface of one molar band to the other. Anteriorly it extends upto the rughae area and is embedded in an acrylic button. The acrylic button that is firmly placed on the rughae provides good anchorage.
- Indicated when there is bilateral missing deciduous molars in the upper arch.
- It can be made active by incorporating 'U' loop to the wire. Opening the loop causes distalization of the first permanent molar.



- The acrylic button may irritate the soft tissues and this appliance may not be suitable for patients allergic to acrylic.



Fig. 9.31: Nance palatal arch space maintainer

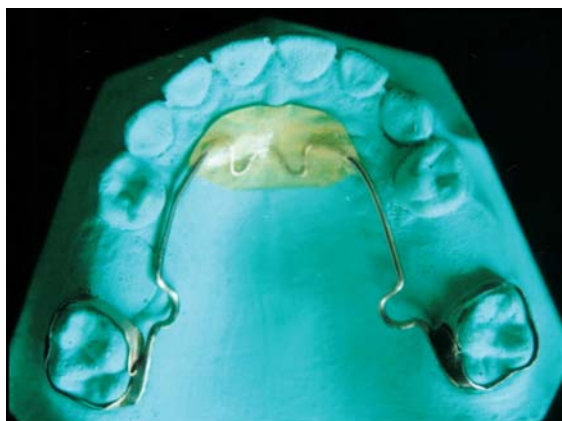


Fig. 9.32: Nance palatal arch space maintainer with 'U' loop

Distal Shoe Space Maintainers (Fig. 9.33)

Early version of distal shoe space maintainer was called as Willet's distal shoe and was made of cast gold. It was very expensive and difficult to fabricate, so it was modified to the present design. It is called as Roche's modified distal shoe appliance.

It is a unilateral, fixed, nonfunctional and passive space maintainer. It is an intraalveolar appliance, in which a portion of the appliance is extending into the alveolus.

Distal Shoe space maintainer is normally not indicated in a maxillary arch. This is because the maxillary permanent molars have a distally inclined path of eruption initially. As they erupt they become more horizontally positioned. In such a situation the mesial migration of the erupting tooth is very rare

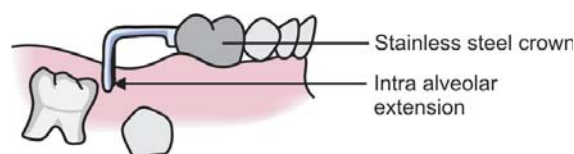


Fig. 9.33: Intra-alveolar extension of distal shoe space maintainer

Indications of Distal Shoe Space Maintainer

- It is indicated when there is premature loss of second deciduous molar before the eruption of the first permanent molar.
- Used only when one tooth is lost on one quadrant as the strength of the appliance is limited. So when both the first and second deciduous molars are missing in the same quadrant, removable distal shoe is preferred.

Contraindication of Distal Shoe Space Maintainer

- Multiple missing tooth
- Lack of abutment teeth
- Poor oral hygiene
- Lack of patient and parent cooperation
- Presence of medical conditions such as blood dyscrasias, congenital cardiac defect predisposing to subacute bacterial endocarditis, history of rheumatic fever, diabetes, general debilitation.

Construction of Distal Shoe Space Maintainer (Figs 9.34A to F)

- The band/crown is adapted on the first deciduous molar and an alginate impression is made. The band/crown is removed from the tooth and placed in the impression and cast is prepared with the band/crown on the cast.
- An IOPA is taken to determine the distance between the alveolar surface and the mesial marginal ridge of the first permanent molar (depth of the intra alveolar extension) and also to measure the distance between the distal surface of the first deciduous molar and the mesial surface of the first permanent molar (space required for the eruption of the second premolar).
- On the cast the position of the mesial surface of the first permanent molar is marked with the help of a divider, from the distal surface of the first deciduous molar.



- A 'V' shaped notch is made at the marked point. The depth of the notch is such that it extends to about 1mm below the mesial marginal ridge of the first permanent molar, as per the measurements made on the radiograph.
- A loop is fabricated that extends from the band / crown on the first deciduous molar upto the slot and then bends at right angles into the slot prepared. The space in between the two portions of the loop can be filled with solder.
- The loop is then soldered to the band, finished and polished. The appliance is sterilized before trying in the patient's mouth.
- It is advised to extract the tooth just before cementation of the appliance as it minimizes the risk of mesial migration of first permanent molar.
- The band/crown is tried in the patient's mouth after the extraction of the mandibular second molar. The intraalveolar portion of the loop extends into the extraction socket. An IOPA is taken to confirm the position of the intralveolar extension. It should lie 1mm. below the mesial marginal ridge of the first permanent molar.
- The band/ crown is then cemented and patient kept on recall until the permanent molar erupts. Then the intraalveolar extension is cut and the appliance acts as a band and bar space maintainer till the second premolar erupts.
- Modification: A crown can be cemented on the abutment tooth and band for the distal shoe adapted on the crown. This provides stability to the design.

The intra-alveolar portion is never totally lined by epithelial tissues and is associated with a chronic inflammatory response.

Situations where distal shoe is contraindicated, 2 options of management are

1. Allow drifting of the first permanent molar followed by regaining the space with the active space maintainer
2. Use of removable appliance that do not penetrate the tissue, but applies pressure on the ridge mesial to the unerupted first permanent molar

Active Space Maintainers/Space Regainers

This type of space maintainer as the name suggests is active and brings about the movement of the tooth/teeth. It can be a removable or fixed, unilateral or bilateral appliance.

Indication of Active Space Maintainers:

- When there is a need to re-establish about 3 mm or less of space.

Factors to be Considered Before Planning for Active Space Maintainer

- It is easy to regain space in maxilla than in mandible, due to increased anchorage provided by the palatal vault and possibility of extraoral anchorage. Also the bone in maxilla is cancellous compared to the compact bone of mandible.
- Space loss by tipping can be regained when the crown of the tooth is tipped back
- Space loss by bodily movement of the adjacent tooth should be regained by moving the tooth back bodily.

Removable Space Regainer

- It consists of retentive components like the Adams clasp, an active component such as springs or screws and a acrylic base plate.
- It is used when space loss is present on one quadrant only.
- It takes about 3-4 months to regain 3 mm of space
- Screw design has the advantage that the tooth to be moved can also be clasped to help retain the appliance.
- Single or double cantilever spring can be used with adequate anchorage.
- Extra-oral force can be applied by the use of headgear. It consists of a face bow, extra oral bow and intra oral arch wire, neck pad and elastic band. 14-16 hours of wearing is required per day and generates 100-200 gm of force.

Fixed Space Regainer

It is a fixed, unilateral, nonfunctional and active space maintainer.



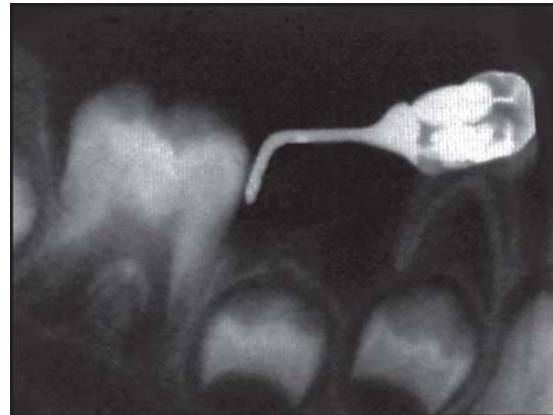
A



B



C



D



E



F

Figs 9.34A to F: Placement of distal shoe space maintainer

- A: Second deciduous molar is advised for extraction. First permanent molar is not yet erupted.
- B: Distal shoe is prepared. The intraalveolar extension is soldered to the crown.
- C: Second deciduous molar is extracted.
- D: The distal shoe is placed on the tooth and radiograph is taken to confirm the position of the intra-alveolar extension with respect to the erupting first permanent molar
- E: The appliance is cemented in place
- F: Postoperative healing seen at the extraction site



Indicated when there is space closure following the premature loss of deciduous molar by mesial drifting of the first permanent molar.

Types of Fixed Space Maintainer

1. Gerber Space Regainer
2. Jackscrew Space Regainer

Gerber Space Regainer (Open coiled space regainer) (Fig. 9.35)

It consists of band adapted on to the tooth and an open coil inserted into a U' shaped wire. The wire is inserted into the molar tube on the band and whole assembly is cemented on the tooth.

Fabrication of Gerber Space Regainer

- The band is adapted on the tooth, generally the permanent first molar that is to be distalized to regain space.
- The buccal and lingual tubes are soldered to the adapted band with the help of a spot welder. These tubes are about 0.25 inches long and have flanges for spot welding.
- The tubes should be parallel to one another in all planes and their lumen should be aimed in between the contact point of crown and the gingiva of the mesial abutment tooth.
- An impression of the band and tubes is taken with the band seated on the tooth and the band is then removed.
- The holes in the tube are plugged with carding wax to prevent them from getting blocked by stone plaster.
- The band is then seated in the impression and stone plaster is poured after stabilizing the same.
- A 0.7 mm stainless steel wire is then bent to a U' shape, which will fit passively in both the buccal and lingual tubes.
- The anterior part of the U' shaped wire should have a reverse bend where it contacts the distal outline of the first premolar. The wire will contact the distal surface of the first premolar below its greatest convexity.

- At the junction of the straight part and the curved part of the wire, both buccal and lingually, solder is flowed to make a stop.
- Then open coil spring is cut enough, so as to extend from the stop to a point about 2 mm distal to the anterior limit of the tube on the molar band.
- The coil spring is slipped on the wire. The wire is then put in the tubes. The band with the wire and compressed springs is cemented on the molar.
- The compressed spring will try to recoil and exert reciprocal pressure mesially to the premolar and distally to the permanent molar.



Fig. 9.35: Gerber Space Regainer

Jackscrew Space Regainer

The jackscrew space regainer is used to recover the loss of space caused by drifting of tooth into an edentulous area.

It consists of 2 banded adjacent teeth and a threaded shaft with a screw and a locknut. This is activated regularly to exert a consistent force against the banded teeth. This appliance produces rapid results.

Fabrication of Jackscrew Space Regainer

- Band is fabricated and impression made
- The cast is poured after transferring the bands on the impressions.
- A 0.036" buccal tube is welded to the molar band.



- The tube should be centered in the middle one-third of the band and aligned with the other banded abutment tooth.
- A jackscrew unit as received from the manufacturer consists of one adjustment nut and one lock nut on a threaded shaft. Slide the threaded end of the shaft into the molar tube.
- The mesial end of the shaft is trimmed and contoured to the premolar band surface and soldered onto the premolar band.
- End of the shaft should be trimmed so that it extends 2 mm from the distal end of the tube.
- It is then cemented into the patient's mouth.

Space Maintainers that can be used for Premature Loss of Deciduous Molars

1. Maxillary anterior teeth
 - Removable functional space maintainer
 - Fixed cantilever prosthesis
2. Mandibular anterior teeth
 - Removable functional space maintainer
 - Fixed cantilever prosthesis
3. Maxillary first deciduous molar
 - Unilateral loss
 - a. Band and loop space maintainer
 - b. Transpalatal arch space maintainer
 - c. Removable functional space maintainer
 - Bilateral loss
 - a. Nance palatal arch
 - b. Two band and loop space maintainer
 - c. Removable functional space maintainer
4. Maxillary second deciduous molar
 - Unilateral loss
 - a. Band and loop space maintainer
 - b. Transpalatal arch space maintainer
 - c. Removable functional space maintainer
 - Bilateral loss
 - a. Nance palatal arch
 - b. Two band and loop space maintainer
 - c. Removable functional space maintainer
5. Mandibular first deciduous molar
 - Unilateral loss
 - a. Band and loop spacemaintainer
 - b. Removable functional space maintainer
 - Bilateral loss
 - a. Lingual arch spacemaintainer – after the eruption of the permanent incisors
 - b. Two band and loop space maintainer
 - c. Removable functional space-maintainer
6. Mandibular second deciduous molar
 - Unilateral loss, before the eruption of first permanent molar –
 - a. Distal shoe space maintainer
 - Unilateral loss, after the eruption of first permanent molar –
 - a. Band and loop spacemaintainer
 - b. Removable functional space maintainer
 - Bilateral loss, before the eruption of first permanent molar –
 - a.. Two distal shoe space maintainer, one on each side
 - Bilateral loss, after the eruption of first permanent molar –
 - a. Lingual arch spacemaintainer – after the eruption of the permanent incisors
 - b. Two band and loop space maintainer
 - c. Removable functional spacemaintainer
7. Maxillary first and second deciduous molars
 - Unilateral loss
 - a. Transpalatal arch space maintainer
 - b. Removable functional space-maintainer
 - Bilateral loss
 - a. Nance palatal arch
 - b. Removable functional space-maintainer
8. Mandibular first and second deciduous molars
 - Unilateral loss
 - a. Removable functional space-maintainer
 - Bilateral loss
 - a. Lingual arch spacemaintainer
 - b. Removable functional space-maintainer
 - Before the eruption of permanent first molars
 - a. Removable functional spacemaintainer



SOLDERING PROCEDURE

Soldering is a process of joining two or more metal components by heating them to a temperature below their solidus temperature and filling the gap between them using a molten metal with a liquidus temperature below 450°C.

The soldering process involves:

1. Substrate metals to be joined
2. A filler metal (usually called solder): The filler metal must be compatible with the oxide-free substrate metal, but it does not necessarily have a similar composition.

Primary properties of filler metal required are:

- Sufficiently low flow temperature
- Ability to wet the substrate metal
- Sufficient fluidity at the flow temperature
- Adequate hardness, strength, tarnish and corrosion resistance
- An acceptable color

3. A flux: Flux is a compound applied to metal surfaces that dissolves or prevents the formation of oxides and other undesirable substances that may reduce the quality or strength of a soldered area.
4. *Heat source*: The portion of the flame used to heat the soldering assembly is at the tip of the reducing zone, because this produces the most efficient burning process and the most heat. An improperly adjusted torch or improperly positioned flame can lead to oxidation of the substrate or filler metal and may result in a poor solder joint.

All are equally important, and the role of each must be taken into consideration.

Fluxes may be divided into the following three types, according to their primary purpose:

Type I: Surface protection—Covers the metal surface and prevents access to oxygen so that no oxides can form.

Type II: Reducing agent—Reduces any oxides present and exposes clean metal.

Type III: Solvent—Dissolves any oxides present and carries them away

Technical Procedures

The soldering technique involves several critical steps:

1. Cleaning and preparing the surfaces to be joined.
2. Assembling the parts to be joined.
3. Preparing and fluxing the gap surfaces between the parts.
4. Maintaining the proper position of the parts during the procedure.
5. Controlling the proper temperature.
6. Controlling the time to ensure adequate flow of solder and complete filling of the solder joint.

Flow temperature is that temperature at which the filler metal wets and flows on the substrate metal and produces a bond. The flow temperature of the filler metal should be lower than the solidus temperature of the metals being joined. A general rule is that the flow temperature of the filler metal should be at least 55.6°C (100°F) lower than the solidus temperature of the substrate metal.

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Chapter 10



Pernicious Oral Habits

1. Introduction
2. Definition
3. Factors that Make a Habit–Pernicious
4. Classification of Pernicious Oral Habits
 - Morris and Bohana
 - Earnest Klein
 - Brash
 - Sydney Finn
 - William James
5. Thumb Sucking Habit
6. Tongue Thrusting Habit
7. Mouth Breathing Habit
8. Bruxism
9. Lip Biting and Mentalis Habit
10. Nail Biting Habit
11. Self Destructive Oral Habits / Masochistic Habits



INTRODUCTION

Pernicious oral habits are habits which are abnormal and results due to lack of harmony between the child and his environment.

Most of the oral habits produce harmful effects on the development of the maxillofacial complex, leading to unbalanced pressure exerted on the immature and highly malleable alveolar ridges and potential changes in the position of the teeth and occlusion.

The habit can be acquired by imitation from others or may infuse a certain sense of security and comfort, as the child seems to retire to his world of fantasy, thus becoming cut out to any situation which otherwise promotes a feeling of fear and distress.

DEFINITION

Pernicious means: tending to a fatal issue.

“Habit is defined as an automatic response to a specific situation acquired normally as the result of repetition and learning. At each repetition the act becomes less conscious and if repeated often enough, may enter the realm of unconscious habit.”

When the habit involving the oral cavity becomes fatal, that is when the habit causes defects in orofacial structures it is termed as pernicious oral habit.

FACTORS THAT MAKE A HABIT—PERNICIOUS

A habit is considered to be pernicious when they interfere with the child's physical, emotional or social functioning. The severity of the ill-effects of a habit depends upon the frequency, intensity and duration for which the habit is practiced.

Frequency—How often the habit is performed (number of times per day).

Intensity—How vigorously is it practiced?

Duration—Total number of years/months/weeks/days since the habit is being performed.

CLASSIFICATION OF PERNICIOUS ORAL HABITS

Pernicious oral habits can be classified as follows:

By Morris and Bohana

- Pressure habits – thumb sucking, tongue thrusting, etc.
- Non-pressure habits- mouth breathing, etc.
- Biting habits- pencil biting, etc.

By Earnest Klein

- Intentional habits- (meaningful)
 - Unintentional habits-(empty)
- A habit can be either meaningful or empty, e.g. let us assume that a 5 years old child is left in the care of a baby sitter for a period of 3 months, while the parents are away for a vacation. The child is horrified by the belief that his parents have deserted him. He is lonesome and develops feeling of insecurity and resorts to thumb sucking. Under these circumstances sucking the thumb becomes an ‘meaningful habit’, where there is direct cause and effect relationship. This habit becomes an ‘empty habit’, if the child continues to suck his thumb after his parents return home, because now the cause is removed but the effect remains.

By Brash

- Purely muscular, e.g. tongue thrusting, lip sucking.
- Combined activity of the muscles of jaw, mouth and thumb, e.g. thumb sucking.
- Muscular action combined with introduction of passive object into the mouth, e.g. pencil chewing.
- Habits in which muscles of the mouth and jaw take no active part, the effect on the position of the teeth are produced by extraneous pressure, e.g. abnormal pillowing.
- Functional disturbance, e.g. mouth breathing.

By Sydney Finn

- Non-compulsive:** Habits which are easily added or dropped from the child's behavior pattern as he/she matures.



- b. *Compulsive*: It is acquired and express a deep seated emotional need.

By William James

- a. Useful habits, e.g. nasal breathing
b. Non-useful habits/harmful habits, e.g. mouth breathing.

Points to consider before treatment of oral habits:

1. Is the habit normal for that age? e.g. tongue thrusting or thumb sucking in an infant is normal.
2. Why has the child acquired the habit? Can it be a meaningful or empty habit?
3. Is the habit self correcting, damaging or persisting? e.g. thumb sucking is normal in infants and self correcting with the advancing age.
4. What is the correct time of interception for correction?
5. Is the habit potentially harmful to the mouth or the paraoral structures? Intensity, duration, and frequency are the index of severity of the habit should also be considered.
6. Psychological implication for allowing or not allowing the child to continue the habit, especially in an meaningful habit.
7. First the psychological problem should be treated then the habit as such.
8. What is the appropriate means of correction of the habit?
9. Parental attitude as an important factor.

THUMB SUCKING HABIT

It is observed that most of the children below 3 years suck their thumb or finger. Thumb sucking in infants is common and is meant to meet both psychological and nutritional needs. It is a spontaneous activity that develops soon after birth. Between birth and 3 months of age, its intensity increases until the age of 7 months and then gradually declines. Most of the children discontinue the habit by 3-4 years of age. If the habit continues beyond this period there are definite chances that it may lead to dentofacial changes, and the severity depending on the frequency, duration and intensity of the habit.

Definition of Thumb Sucking

According to Gellin “it is the placement of thumb or one or more fingers in varying depths into the mouth”.

Classification of Thumb Sucking

According to Cook (Fig. 10.1)

1. α group: The thumb pushes the palate in a vertical direction and displays only little buccal wall contractions. Here the thumb applies pressure on the palate but sucking action is minimum or nil. Characteristic features therefore seen will be a deep palate with no posterior cross bite.
2. β group: Strong buccal wall contractions are seen and a negative pressure is created resulting in posterior cross bite.
3. γ group: Alternate positive and negative pressure is created. Posterior cross bite may be a feature in some cases depending on the frequency and duration of habit.



A



B

Figs 10.1A and B: Position of the thumb as per Cook's classification; A: Little or no buccal wall contraction; B: Buccal wall contraction seen during thumb sucking habit



According to Subtleny (Figs 10.2A to D)

1. *Group I:* Thumb is inserted beyond the first joint, pressing against the palatal mucosa and alveolar tissue. Lower incisors press against the thumb.
2. *Group II:* The thumb extends upto the first joint or just anterior to it. No palatal contact. Contact is present with only the anterior teeth.
3. *Group III:* Thumb is placed fully into the mouth in contact with the palate as in group I but the lower incisors do not contact the thumb.
4. *Group IV:* The thumb does not progress appreciably into the mouth. The lower incisors contact the thumb at the nails.



A



B



C



D

Figs 10.2A to D: Position of the thumb as per Subtleny's classification; A: Thumb is inserted beyond first joint and lower incisors presses over the thumb; B: Thumb is inserted slightly anterior to the first joint but contact is made only with incisors; C: Thumb is inserted beyond first joint but lower incisors do not contact the thumb; D: The lower incisors contact the thumb at the nails



Theories Explaining Thumb Sucking Habit

Various theories have been discussed to explain the development of thumb sucking habit. They are:

Psychosexual/ Psychoanalytical Theory

Formulated by S. Freud, according to which thumb sucking habit evolves from an inherent psychosexual drive where the child derives pleasure during sucking the thumb. It views continuation of the habit as the manifestation of an underlying psychological disturbance and therefore as a mechanism for stress management. Elimination of the habit may cause it to be substituted by other antisocial activities.

Oral Drive Theory

It is formulated by Sears and Wise. According to this theory prolongation of nursing strengthens the oral drive and child begins thumb sucking.

Benjamin's Theory

According to this theory thumb sucking arises from the rooting reflex common to all mammalian infants. This primitive reflex is maximal during the first 3 months of life. If it persists into later life it can lead to an abnormal habit.

Rooting reflex—is the movement of an infant's head and tongue towards a stimulus touching an infant's cheek.

Learning Theory

According to this theory habit stems from an adaptive response and assumes no underlying psychological cause and acquired as a result of learning.

Clinical Features of a Child Practicing Thumb Sucking

When a thumb is sucked, it can be positioned in varying positions inside the mouth as explained in the classification and the other fingers are most of the time rolled into a fist or curled over the bridge of the nose or (Figs 10.3A and B).



A



B

Figs 10.3A and B: Thumb or any finger (Digit sucking) can be used for sucking; A: Fingers are rolled into a fist while thumb sucking; B: Index finger is used for sucking

Changes seen in Orofacial Structures (Fig. 10.4)

1. Labial flaring of maxillary anterior teeth
2. Lingual collapse of mandibular anterior teeth
3. Increased overjet
4. Hypotonic upper lip and hyperactive lower lip
5. Tongue placed inferiorly leading to posterior cross bite due to maxillary arch contraction
6. Associated with simple tongue thrust, which is an adaptive response to open bite
7. Narrow nasal floor and high palatal vault



8. Some craniofacial skeletal changes may also be seen
9. Fungal infection, keratotic lesions- on the thumb
10. Thumb nail exhibits dish pan (concave) appearance.



A



B

Figs 10.4A and B: Clinical features of thumb sucking; A: Labial flaring of maxillary anterior teeth; B: Hypotonic upper lip

Factors Influencing the Severity of Dental Defects due to Thumb Sucking

The type of malocclusion depends upon:

1. *Position of the digit:* The effect of thumb sucking depends whether the thumb is placed just at the entrance of the oral cavity or is it placed very inside touching the palate. If the thumb is placed just at the entrance there may not be any palatal changes observed.
2. *Associated orofacial muscle contraction:* Whether the child is actively involving orofacial muscles. When there is associated muscle contraction the intensity of the defects greatly increases.

3. *Position of mandible during sucking:* When the mouth is kept open the tongue is carried down along with the lower jaw. Thus during swallowing there is only buccal muscle contraction (As the thumb is inside the mouth most of the time) and thus the force applied on the molars is one sided. The tongue being in a lowered position fails to exert reciprocal force from the lingual side. This may cause posterior cross bite.
4. *Facial skeletal morphology:* Straight profile withstands the effects of thumbsucking better than typical Class II facial skeleton. Therefore a mild habit may be more detrimental in some faces than a severe one in others.
5. *Duration, intensity and frequency of the habit:* Increase in all the three factors results in severe changes in orofacial structures.

The Three Distinct Phases of Development of Thumb Sucking Habit

The development of thumb sucking can be divided into three distinct phases.

Phase 1: Extends from birth to 3 years normal and subclinically significant sucking. This period is considered normal and does not require any intervention. It should be kept in mind at the end of this stage that any vigorous thumbsucking may be carried into the next phase which then becomes abnormal. So preventive measures can be instituted and thumb substituted by physiological pacifiers.

Phase 2: Extends from 3 to 6-7 years. It is associated with clinically significant sucking. The habit may be meaningful or empty. It is necessary to manage or correct the habit at this stage.

Phase 3: Intractable sucking. When the habit proceeds into phase 3, problem becomes more serious and may require psychotherapy.

Management of Thumb Sucking Habit

Steps in the management of thumb sucking habit:

Discussion with the Child

- The first step in the treatment of the habit is to make the child understand that the habit is going to cause problem to him/her and needs to be stopped. Any



measure to stop the habit is possible only when the child fully cooperates.

- Second important step is to differentiate whether the habit is a meaningful or an empty habit. Meaningful habit is managed by treating the etiology first and then the practice or ill effects of habit.
- No threats or shamming should be done. Friendly attempts made to learn about child's attitude towards the habit
- Photographs, video or casts of other child before and after treatment is shown.
- **Dunlop β hypothesis:** The patient is made to sit in front of the mirror and asked to suck his thumb. This will make him realize, how awkward he looks and wants to stop sucking his thumb.
- Child is given a card to score the number of times he has sucked his thumb. After 2 weeks it is assessed to study the severity of the habit. The process of keeping the record will tend to reduce the number of times the child sucks the thumb.
- Be supportive and let the child know that you want to help him.

Discussion with the Parents

- The habit should not be made the topic of discussion at home and the child should not be ridiculed.
- Most of the children will loose the habit by the end of this phase.

Use of Habit Reminders

- Bitter substance/ nail polish applied on the thumb can also be used as reminders to withdraw or prevent the thumb from entering into the mouth.
- **Habit reminders:** It is also advocated in children who are aware of the ill effects and want to discard the habit. Patient cooperation is very important. Habit reminders reminds the child of the habit whenever he puts his thumb into the mouth. Thumb guard made of acrylic or gauze (Fig. 10.5) will remind the child as the thumb is taken to the mouth and also the child does not derive any pleasure sucking the thumb guard. Other appliance that can be used as reminders which are inserted onto the tooth are

palatal bar, hay rake etc. (Fig. 10.6). These appliances can be removable or fixed.

- If there is nocturnal component, an elastic bandage may be wrapped loosely from the middle of the forearm to the biceps area to prevent the thumb reaching the mouth (Fig. 10.7). The child (and not the parent) can also place thumb bandage at night as reminder.



A



B

Figs 10.5A and B: Thumb guard; A: Acrylic guard; B: Gauze wrapped around the thumb acts as a guard

Ideal appliance for correction of thumb sucking should-

- Offer no restraint to normal muscular activity
- Have no shame attached to its use
- Not or minimally involve parents for placement and removal
- Well adapted, out of the way of normal oral functioning



A



B

Figs 10.6A and B: Habit reminder with palatal rake;
A: Removable; B: Fixed

The habit will usually be broken by the end of 3 weeks and the child must be rewarded at the end. Habit reminders should be left in the mouth for 6 months as retainer. Next 3 months are needed to correct posterior cross bite with quad helix and 3 months are required for stabilization.

TONGUE THRUSTING HABIT

Definition

Norton and Gellin defined tongue thrust “as a condition in which the tongue protrudes between the anterior or posterior teeth during swallowing with or without affecting tooth position”.

Different types of Tongue Thrusting Habits

According to Moyer

- A. Normal swallow: (a) Infantile swallow, (b) Adult swallow
- B. Simple tongue thrust
- C. Complex tongue thrust
- D. Retained infantile swallow.

According to Backlund

1. *Anterior tongue thrust*: Associated with forceful anterior thrust
2. *Posterior tongue thrust*: Associated with lateral thrust of the tongue usually seen when there is any missing tooth/teeth.

Clinical Features

Features of Infantile Swallowing Pattern

- Tongue lies between the gum pads
- Mandible is stabilized by obvious contraction of facial muscles especially the buccinator
- Seen in neonate and gradually disappears with eruption of teeth and growth of mandible
- It is due to the differential growth of tongue and jaws. The growth of the tongue is nearing completion at birth compared to the jaws thus the tongue is relatively bigger to be accommodated in a smaller jaw. Later as the jaw grows it can accommodate the



Fig. 10.7: Elastic bandage wrapped around the arm and forearm



tongue explaining the lower incidence of tongue thrusting with age.

Features of Adult Swallowing Pattern

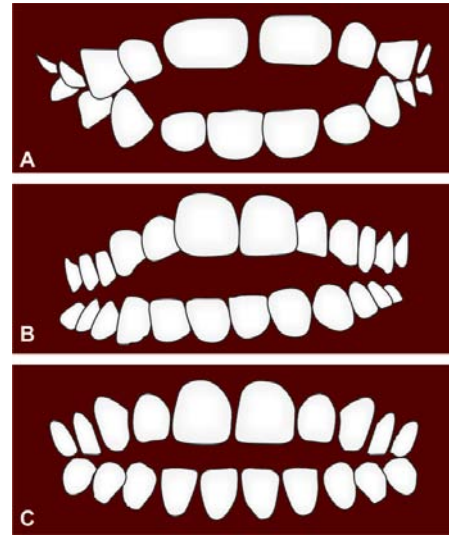
- As a person swallows the tip of the tongue contacts the palatal rugae posterior to the maxillary anterior teeth, mid portion contacts the hard palate and the posterior aspect assumes a 45° angulation against the posterior pharyngeal wall to permit the bolus of food to move into the digestive tract.
- Facial expression muscles are passive but mandibular elevators are contracted. Thus during a normal adult swallow there is no contraction of muscles of facial expression including the lips and cheek.

Features of Swallow Associated With Simple Tongue Thrusting (Fig. 10.8A)

- Simple tongue thrusting is associated with teeth together swallow
- There is associated contraction of lip, mentalis and mandibular elevators. So when the child swallows tight pursing of the lips with pluckering of the chin due to mentalis contraction is seen
- Well circumscribed anterior open bite is the characteristic malocclusion observed
- It may also be due to some adaptive mechanism as observed in thumbsucking habit, which is associated with anterior open bite. When the child want to swallow the anterior open bite is sealed by the tongue to create a vacuum so as to complete the act of swallowing resulting in anterior tongue thrusting
- Posterior teeth are in stable interdigitation.

Features of Swallow Associated with Complex Tongue Thrusting (Fig. 10.8B)

- The teeth do not occlude when the child swallow and is termed as teeth apart swallow
- Poor occlusal interdigitation with generalized anterior open bite is characteristic
- Combined lip, facial and mentalis contraction is observed
- Lack of contraction of mandibular elevators



Figs 10.8A to C: Dental defect seen in different types of tongue thrusting habit; A: Swallow associated with simple tongue thrusting; B: Swallow associated with complex tongue thrusting; C: Retained infantile swallow

- Tongue thrusts in between the teeth
- Likely to be mouth breathers.

Features of Retained Infantile Swallow (Fig. 10.8C)

- Seen due to undue persistence of the infantile swallow
- Usually occlude on one molar in each quadrant
- Strong contraction of facial muscles during swallowing
- Tongue protrudes markedly and is held between all the teeth during the initial stages of the swallow
- Expressionless face
- Children restrict themselves to soft diet.

Reasons for the Prevalence of Tongue Thrusting Habit in Children

It may be due to:

1. The comparative largeness of the tongue within a retrognathic not fully developed mandible causing the tongue to protrude out.
2. Enlarged adenoid and palatine tonsils.

It is very common in children and results in blockage of nasopharynx leading to mouth breathing. This in turn may lead to tongue thrust during swallowing



3. As associated with thumb sucking habit—Thumb sucking may result in anterior open bite leading to tongue thrust associated swallowing pattern.
4. Malocclusion—The incidence of tongue thrusting during swallowing has been reported to be higher in children with malocclusion than in children with good occlusion.

Investigative Methods for Identifying Tongue Thrusting Habit

Methods of Examination

- A. *Patient is seated upright:* A little water is placed in the patient's mouth and the patient is asked to swallow it.

During normal swallowing pattern:

- The mandible rises as teeth are brought together
- The lips touch each other lightly showing scarcely any contraction
- Facial muscles do not show any marked contraction

During abnormal swallowing:

- The teeth are apart
- The lips are pursed tightly and active contraction is seen
- Contraction of muscles of facial expression is clearly seen

- B. Examiner's hand is lightly placed over the temporalis and the patient is asked to swallow the water

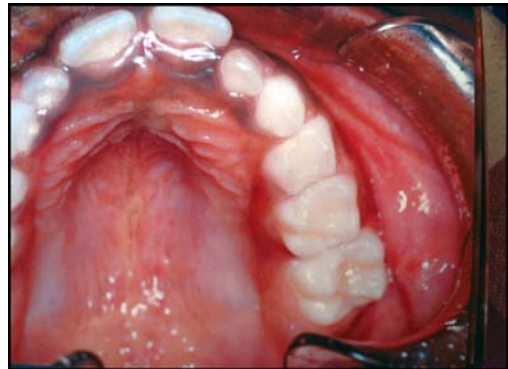
- During the normal swallowing the temporalis muscle contracts as the mandible is elevated
- During teeth apart swallow, no temporalis contraction can be felt.

- C. The lower lip is lightly held with thumb and finger and the patient is asked to swallow the water.

- During the normal swallowing process, the patient is able to swallow normally
- In the abnormal swallowing pattern, the swallow will be inhibited, as strong mentalis and lip contractions are needed for mandibular stabilization and the water will spill out of the mouth.



A



B



C

Figs 10.9A to C: Features of tongue thrusting habit; A: Anterior Proclination; B: Narrow palate; C: Tongue is seen thrusting into the edentulous space cause due to exfoliation of the incisors

2. Anterior open bite
3. Short and flaccid upper lip
4. Posterior cross bite.

General Clinical Features of Tongue Thrusting Habit (Figs 10.9A to C)

1. Proclination and flaring of incisors resulting in midline diastema.

Prognosis

Simple tongue thrust	—	Excellent
Complex tongue thrust	—	Good
Retained infantile swallow	—	Very poor



Management of Tongue Thrusting Habit

The management of tongue thrusting habit is aimed at teaching the child the correct positioning of the tongue. This can be done by:

1. The patient is instructed to put the tip of the tongue at the correct position and swallow with lips pursed and teeth in occlusion. This helps the patient to learn a new reflex on the conscious level (40 times/day in 2-3 sessions).
2. A flat sugarless fruit drop can be placed on the back of the tongue and it is held against the palate in the correct position until it completely dissolves. This is practiced once or twice a day.
3. When the patient learns normal tongue position this has to be reinforced and made into an unconscious act.

The appliance therapy is initiated for children above 9 years.

Appliances used can be either fixed with bands and palatal rake or removable with Adam's clasp and Jackson's crib.

MOUTH BREATHING HABIT

Mouth breathing can be defined as habitual breathing through mouth instead of the nose. Breathing can be achieved through nose or mouth. A nasal breather can quickly change the mouth breathing during the strenuous exercises. Thus a mouth breather is one who breathes orally even in relaxed and stressful situation.

Etiology of Mouth Breathing Habit

It is estimated that 85% of the mouth breathers suffer from some degree of nasal obstruction while 20% are habitual mouth breathers.

Etiology can be due to:

- Anatomic (e.g. short upper lip, DNS),
- Pathological (enlarged adenoid, nasal polyps, etc.)
- Habitual.

Clinical Features Seen in Mouth Breathing Habit

Facial appearance of a child with mouth breathing habit is termed as **Adenoid Facies** and is characterized by:

- Long narrow face, narrow nose and nasal passage
- Flaccid and short upper lip
- Dolicofacial skeletal pattern
- Nose tipped superiorly
- Expressionless face
- Narrowed maxillary arch
- Labial flaring of the maxillary incisors
- Mouth breathing gingivitis
- Anterior open bite
- Increased caries incidence in maxillary anterior teeth.

Examination of a Child for Mouth Breathing Habit

Examination is done as follows:

1. Observe the patient unknowingly while at rest,
In a nasal breather – The lips touch lightly
But in a mouth breather – The lips are kept apart
2. Patient is asked to take deep breath
Nasal breather keeps the lips tightly closed
Mouth breather takes a deep breath, keeping the mouth open.
3. Ask the patient to close the lips and take a deep breath through the nose.
Nasal breather – Demonstrates good control of alar muscles which control the size and shape of external nares. So dilatation and contraction of nares is present
Mouth breather – May be capable of breathing through nose, but do not change the size or shape of the external nares.
4. *Butterfly test*: Take a piece of cotton and shape it into a butterfly. Place it on the philtrum and check for the movement of the cotton fibers. If they are moving in a direction towards the nose then the patient is a mouth breather.
5. *Two surface mirror test*: A double sided mouth mirror is taken. It is kept on the philtrum. If the fog if formed on the mirror facing the mouth, then the patient is a mouth breather.
6. *Water test*: The patient is asked to hold a mouthful of water for few minutes without swallowing. If the patient is a mouth breather he/she will not be able to hold the water in the mouth for long period.



Management of a Child with Mouth Breathing Habit

Management includes:

1. Identification and correction of nasal obstruction.
2. Physical exercise - respiratory exercise
 - lip exercise- horn and flute
 - stretching and twisting of upper lip
3. Mechanical –oral screen.

Oral Screen/Vestibular Screen (Fig. 10.10)

- It is a myofunctional appliance that is easy to fabricate and easy to wear.
- It is curved corresponding to the curvature of the arch and is made of acrylic.
- It works on the principle of both force application and force elimination.
- Posterior cross bite can be corrected utilizing the principle of force elimination by providing a spacer between the teeth and the screen.
- Anterior teeth proclination can be corrected utilizing the principle of force application. This is possible by making the screen come in contact with the proclined teeth so that the forces from the lips are transmitted directly to the proclined teeth through the screen.
- Oral screen can be used for the correction of mouth breathing, thumb sucking, lip biting or cheek biting habits.
- Lip exercises are possible with oral screen, which improves the tonicity of the lips.
- **Construction:** Upper and lower impressions are made and cast prepared. The casts are occluded in centric occlusion and sealed. Posteriorly the appliance will extend upto the distal margin of the last erupted teeth. The upper and lower borders will extend to the full depth of the sulcus. The modeling wax of about 2-3 mm is adapted over the labial, buccal and alveolar surface. Window in the wax is made over the incisal one third of the proclined anterior teeth, so that the acrylic will touch the teeth directly. The appliance is then fabricated with self cure or heat cure acrylic. The wax spacer is removed. The appliance is finished and polished.

- The appliance has to be worn for 2-3 hours during the day and during the sleep at night.
- When the appliance is worn there is a space between the buccal surface of the posterior teeth and the oral screen. In the anterior region the oral screen touches the proclined incisors.
- Patient is taught few lip exercises to improve the tonicity of the lip. The child holds the ring and tries to pull the oral screen out of the mouth. Simultaneously the lips are tightly pursed so that the appliance does not come out of the mouth. This improves their tonicity and increases their length. During these lip exercises the forces exerted by the lip is transmitted to the proclined teeth through the oral screen. Posteriorly the buccal musculatures are kept away from the teeth and are prevented from exerting force on the teeth. This helps in arch expansion by the constant force applied by the tongue from the palatal aspect.
- **Modifications:**
 - If the patient feels difficult to breathe, then multiple holes can be made that are closed one by one over a period of time.
 - A metallic ring is made and placed in the midline of the appliance which will help to hold the oral screen (Hotz Modification).
 - Double oral screen – can be given with a similar additional lingual screen in tongue thrusting habit.



Fig.10.10: Oral screen



BRUXISM

Definition

Poselt and Wolff: Described bruxism as the “clenching or grinding of teeth when not masticating or swallowing”. The habit may occur only during sleep, during the waking hours or both. About 15% of children and young adults practice bruxism.

Etiology

Causes are:

1. Psychic tension associated with any kind of stress.
2. Occlusal interference due to faulty restoration, malocclusion, etc.
3. Intestinal parasites, subclinical nutritional deficiency, allergy and endocrine disturbance.

Features

They are as follows:

1. Occlusal surfaces are worn considerably with exposing dentin or even the redness of dental pulp may show through dentin. Rarely is there any pulp exposures as there is formation of secondary dentin.
2. Masticatory muscle soreness
3. TMJ pain
4. Trauma to the periodontium.

Management

Management of bruxism can be categorized as:

1. Adjunctive therapy:
 - a. *Psychotherapy*: Aimed at lowering emotional or psychic tension
 - b. *Auto suggestion and hypnosis*: Where the patient becomes conscious of his nervous habit and understands the possible consequence
 - c. *Relaxing exercise and physiotherapy*: Serve to decrease muscle tension and bruxism. Exercise and massage may relieve pain
 - d. *Elimination of oral pain and discomfort*: Pain associated with periodontal disease, lip and cheek should be eliminated.
2. Occlusal therapy:
 - a. *Occlusal adjustments*: Bite raising crowns, splints and elimination of occlusal interference

- b. *Bite plates and splints*: The purpose is to stop bruxism by elimination of occlusal interference, to avoid occlusal wear, to restrict the jaw movements and break the habit
- c. Occlusal reconstruction and prosthesis
- d. *Bite guard*: Prevents continual abrasion of teeth. Tranquilizers have been helpful in overcoming bruxism.

LIP BITING AND MENTALIS HABIT

Normal lip anatomy and function are important for speaking, eating and maintaining a balanced occlusion. Lip biting may or may not be associated with mentalis habit.

Features of Lip Biting and Mentalis Habit

Lip biting habit may take on many forms. Two extreme types extends from mild wetting the lips with the tongue to pulling the lips into the mouth between the teeth (Figs 10.11A and B).

Mentalis Habit

The vermillion border of the lower lip is often everted with the lingual aspect elevated into the mouth along with the appearance of sub-labial contracture line between the lip and chin.



A



B

Figs 10.11A and B: Different types of lip biting; A: Mild wetting of the lip by the tongue; B: Biting of the lip

**Changes Seen Due to the Lip Biting Habit**

- Labial placement of maxillary incisors
- Collapsed lower incisors
- Increased overjet
- Reddened, irritated and chapped area below the vermillion border and is usually seen in the lower lip
- Can be associated with mentalis habit.

Management of Lip Biting Habit

Management includes:

1. Visual education
2. Lip bumper (Fig. 10.12) makes it difficult to draw the lower lip between the teeth
3. Correction of the overjet
4. Oral screen.



Fig.10.12: Lip bumper

NAIL BITING HABIT**Features and Management**

Nail biting habit is found among children, with marked increase from ages 3 to 6 years. From 7 to 10 years the incidence remains relatively constant and again rises at 10 years. About 40% of the adolescents are nail biters. It may be a reflection of anxiety or personal adjustment.

Nail biting does not significantly harm the occlusion and the children are self conscious and embarrassed about the habit themselves. The effective treatment consists of identifying the cause and its correction. In some instances, mesial rotation and notching of the central incisors may be observed.

Treatment

Management is similar to thumb sucking, that is:

1. Discussion with the child

2. Discussion with the parents
3. Habit reminders.

SELF DESTRUCTIVE ORAL HABITS/MASOCHISTIC HABITS

Masochistic habits include picking at the gingiva with fingers and finger nails, chewing the inside of the cheek, lip or tongue. It has been associated with Lesch – Nyhan and de Lange's syndromes.

Diverting the child's attention each time the habit is observed can solve this problem. If the habit is the outward manifestation of deeper emotional problems, consultation with psychiatrist is advised. Restraints, protective padding, sedation can be used in mentally retarded children.

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Chapter 11



Dental Caries

1. Introduction
2. Etiology of Caries
3. Role of Trace Elements
4. Mechanism of Dental Caries
5. Microscopic structure of Caries
6. Area Susceptibility for Caries
7. Classification of Caries



INTRODUCTION

Dental caries can be defined as an infectious microbiological disease of the teeth that results in localized dissolution and destruction of the calcified tissues. It is derived from Latin word meaning to 'Rot' or 'Decay'

Pits and fissures on the tooth surface are at the highest risk for the development of caries as they provide excellent areas of retention for microorganisms. The appearance of *Streptococcus* in the pits and fissures is usually followed by caries 6 to 24 months later.

Interproximal areas are also at risk as they are not exposed to tongue movements, salivary flow and the effects of mastication of food.

The facial and lingual surface, below the height of contour is not cleaned daily during the process of mastication. Therefore these surfaces are habitats for caries producing mature plaque.

ETIOLOGY OF CARIES

Caries is a multifactorial disease with interplay of many factors. Key's triad (Fig.11.1) explains the interplay of the host (the tooth and saliva) microflora and substrate (food). Many modifications of this interplay have evolved. One such modification considers saliva as a separate unit and involves an addition of time factor (Fig.11.2).

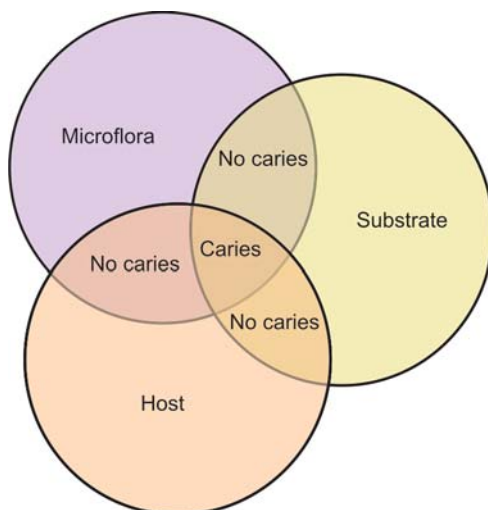


Fig. 11.1: Key's triad

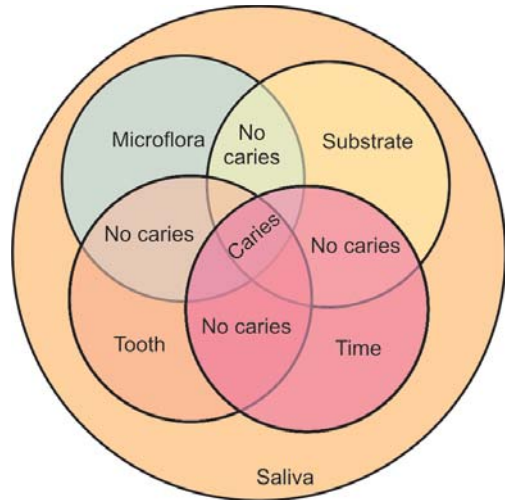


Fig. 11.2: Modification of key's triad

Role of Tooth in the Etiology of Caries

It depends upon:

- Anatomic characteristics of the teeth
- Arch form
- Presence of dental appliances and restoration
- Composition.

Anatomic Characteristics of the Teeth (Fig. 11.3)

The teeth require additional 2-3 years for post eruptive maturation through exposure to saliva. Permanent molars have incompletely coalesced pits and fissures that allow the dental plaque material to be retained at the base of the defect in contact with exposed dentin. The palatal pits of the maxillary molars, the buccal pit of the mandibular molars and the palatal pits on the maxillary incisors are very vulnerable for development of caries.

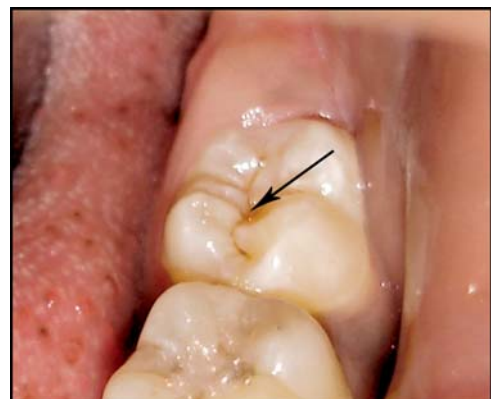


Fig. 11.3: Deep pits and fissures are at increased risk for caries



Arch Form (Fig. 11.4)

Crowding and overlapping of teeth increases the risk of caries due to the presence of areas of stagnation for accumulation of plaque and also these areas are difficult to clean.



Fig. 11.4: Areas of overlap or crowding are at risk for developing caries

Presence of Dental Appliances and Restoration (Fig. 11.5)

All these encourage the retention of food debris and plaque. It is observed that patients with moderate caries activity in the past have experienced increased caries activity following placement of prosthesis.



Fig. 11.5: Margins of the appliance helps in retention of plaque

Composition of the Teeth

Surface zone of enamel is more resistant to caries compared to the inner layers due to the presence of

- Dicalcium phosphate dihydrate (DCPD) and fluorapatite
- Increased mineral and less organic matter

- Decreased water content
- Increased fluoride, chloride, zinc, lead and iron
- Decreased carbonate, and magnesium.

Role of Saliva in the Etiology of Caries

It depends upon the following properties of saliva.

- Composition
- Flow rate
- Salivary buffers
- Viscosity
- Antibacterial property

Composition of Saliva

There seems to be existing a direct relationship between caries prevalence and salivary amylase, urea, ammonia, calcium, phosphate, pH, etc.

Saliva of caries immune persons exhibit increased ammonia content which helps in neutralizing acids. Increased ptyalin in the parotid secretions is also associated with low caries due to its amylolytic activity.

Submandibular secretion has 50% more calcium than parotid (6.8 mg/100 ml and 4.1 mg/100 ml respectively), so increased calculus is seen in mandibular anterior teeth.

Flow Rate of Saliva

Decreased salivary flow is associated with increased caries activity. Xerostomia is associated with cervical caries similar to the rampant caries.

Changes in bacterial flora is observed with decreased salivary flow rate. There is an increase observed in *S. mutans*, *Lactobacillus* species, yeasts, *Actinomyces* and *Staphylococcus* levels, and an decrease in *Veillonella*, *Strep. sanguis*, *Neisseria*, *Bacteroides* and *Fusobacterium* species.

Physiologic xerostomia occurs during sleep, so it is important to brush the teeth before sleeping as there is no saliva to buffer or wash away fermentation products.

The etiology of xerostomia

Sarcoidosis, Sjögren's syndrome, therapeutic irradiation, surgical removal of salivary glands, anticholinergic drugs, antihistamins, antidepressants, diabetes mellitus, viral disease of the gland, etc.



Salivary Buffers

Chief buffer systems present in the saliva are mainly bicarbonates. Carbonic acid and phosphates to certain extent and ammonia to a lesser extent act as buffers.

HCO_3 is more effective because

- It can buffer rapidly by losing carbon dioxide
- Its pH is close to that encountered in plaque, so it is effective in that range
- Increased flow results in increased bicarbonate release but less phosphate.

Critical pH is that pH at which any particular saliva ceases to be saturated with calcium and phosphate. Below this value the inorganic material of the tooth may dissolve. The critical pH is 5.5.

Viscosity of Saliva

High caries incidence is associated with thick mucinous saliva as the saliva lacks its 'washing effect'.

Antibacterial Property

The antibacterial property of saliva is due to the presence of the following components.

Lysozyme—more in sublingual and submandibular saliva. Increased lysozyme activity is seen in caries free children.

Salivary lactoperoxidase system—peroxidase and thiocyanate act on hydrogen peroxide to produce hypothiocyanate. This in turn inactivates various bacterial enzymes and temporarily inhibit growth.

Immunoglobulin—secretory IgA is secreted in the saliva and has antibacterial property.

Microflora

Bacterial Colonization in the Oral Cavity

The type of bacteria seen in the oral cavity varies with age.

- Within hours of birth;
 - S. salivarius*, *S. mitior* form about 70%
- 1st year of life;
 - a. Dominant: *Staphylococcus*, *Veillonella* and *Neisseria*

- b. Less frequent: *Actinomyces*, *Lactobacillus*, *Nocardia*, *Fusobacteria*
- c. Sporadic: *Bacteroids*, *Candida* and Coliform
- d. Shortly after tooth eruption: *S. sanguis* followed by *S. mutans*.

Bacteria Responsible for Smooth Surface, Fissure and Root Caries Varies

- Smooth surface caries – *S. mutans*, *S. salivarius*
- Fissure caries - *S. mutans*, *S. salivarius*, *S. sanguis*, *S. mitior*, *S. faecalis*, *A. viscosus*, *A. naeslundii*, *L. acidophilus*, *L. casei*
- Root caries - *S. mutans*, *S. salivarius*, *A. viscosus*, *A. naeslundii*

Streptococcus mutans (S. mutans)

S. mutans is the most common microorganism to cause caries. Clark in 1924 isolated a streptococcus strain that predominated in human carious lesions and he named them as *S. mutans*. For the next 40 years *S. mutans* was ignored and was rediscovered in 1960's.

Strepto: means arranged in chains

Coccus: means they are round in appearance

The cell wall is made of carbohydrate of either rhamnose, glucose and galactose or galactose and rhamnose or glucose and rhamnose, which contribute for the antigenic properties.

Antigen responsible for group specificities are present on the cell wall.

S. mutans synthesize an extracellular polysaccharide (mutans) from sucrose using the enzyme glucosyl transferase. This material is composed of α (1-3)-linked glucose and aids in bacterial adhesion and provides energy source when extraneous carbohydrate is lacking. *S. mutans* also produces Lipo Teichoic Acid (LTA) which binds directly to enamel surface, facilitating colonization.

Characteristic Features of Streptococcus mutans

1. Spherical, 0.8-1.0 μ in diameter
2. Gram +ve cocci in short or medium chain
3. Non motile, encapsulated, non sporing, facultative anaerobes and catalase -ve
4. On Mitis-Salivarius agar medium they grow as highly convex to pulvinate (cushion shaped) colonies, that are opaque with surface resembling frosted glass



5. Produce α (green) hemolysis on blood agar
6. In solid media, colony morphology is rough, smooth or mucoid
7. Grow over a relative wide temperature range of 10-42°C, optimum being 37°C
8. Chief fermentation product is lactic acid. Small amount of formic acid, acetic acid and ethyl alcohol are formed
9. When cultured with sucrose, they produce polysaccharide that are insoluble or can be precipitated with one part ethanol
10. Ferments mannitol and sorbitol
11. Uses NH_4 as the source of nitrogen, which gives them ecological advantage
12. Cultural characteristics:
 - Can be cultured in the presence of non-inhibition concentration of sulfonamide, which helps in isolation of particular bacteria
 - Grown on Mitis-Salivarius agar containing 20% sucrose and 0.2 units/ml bacitracin, which suppresses other bacterial growth.

Properties of S. mutans

1. It can induce caries in experimental animals fed with high sugar diets
2. It is rarely found outside the mouth and appears to require a solid surface on which they colonize
3. They synthesize extracellular polysaccharide from sucrose using enzyme glucosyl transferase
4. Produce considerable amount of lipoteichoic acid
5. More aciduric than other streptococci
6. Produce acid in greater amount in solid media
7. Contain lysogenic bacteriophage
8. It is a homofermentative lactic acid former.

Ecology of S. mutans

S. mutans can survive in the mouth only when solid surface such as teeth or dentures are present. But it does not uniformly colonize all tooth surfaces and instead localizes on certain surfaces. It is influenced by variety of factors like diet, topical fluoride, systemic antibiotics, oral hygiene, salivary composition and flow rate, microbial interaction in plaque and host immunity.

Human salivary concentration of *S. mutans* range from undetectable to 10^6 - 10^7 CFU/ml. Mothers with $> 10^5$ CFU/ml of salivary *S. mutans* concentration are likely to infect their infants.

Concentration of *S. mutans* in saliva regulates the frequency of colonization of the tooth surface. *S. Mutans* can be implanted to different sites on human teeth through explorer tips and dental floss.

A stable increase in *S. mutans* at a particular site on a tooth was often associated with the development of a lesion at that site.

Plaque

Dental plaque may be readily visualized on teeth after 1-2 days with no oral hygiene measures. It is typically seen in areas where they are not debrided mechanically or by the movement of food over the teeth. Such areas include gingival one third of the tooth surface. Plaque is also deposited in cracks, pits and fissures and on the restorations, etc.

The location and rate of plaque formation vary among individuals and determining factors include oral hygiene, diet factors and salivary composition and flow rate.

Plaque may be detected by running a periodontal probe or explorer along the gingival third of the tooth or by the use of disclosing solution.

It appears as white, grayish or yellow accumulation of variable thickness depending on its location and the extent and frequency of oral hygiene.

Definitions of Plaque

According to Wei—"Plaque is a complex mixture of dense microbial elements enmeshed within a gel like matrix of bacterial polysaccharide, salivary portions and cellular components of the oral mucosa."

According to Sturdevant—"Plaque is a soft translucent and tenaciously adherent material accumulating on the surface of teeth."

According to Loe—"Plaque is a soft, non-mineralized, bacterial deposits which forms on teeth and dental prosthesis that are not adequately cleaned."



According to Glickman— “Plaque is a soft deposits that form the biofilm adhering to the tooth surface or other hard surfaces in the oral cavity, including removable and fixed restorations.”

Facultative aerobes—pertaining to the ability to adjust to particular circumstances

Obligate aerobes—pertaining to or characterized by the ability to survive only in a particular environment.

Structure of Plaque

Based on the location, plaque can be divided into supra gingival and sub gingival plaque.

Supragingival plaque

It is found at or above the gingival margin. When in direct contact with the gingival margin it is referred to as a marginal plaque.

Supragingival plaque is made of 4 layers.

1. Plaque tooth interface
2. Condensed microbial layer
3. Body of the plaque
4. Plaque surface

Subgingival plaque

In children subgingival plaque may appear as either

1. Loose arrangement of mostly cocci
2. Condensed arrangement of cocci and rods or
3. Dense arrangement of cocci covered by a layer of filamentous organisms.

Composition of Plaque

Plaque is composed primarily of microorganisms. One gram of plaque (wet weight) contains approximately 2×10^{11} bacteria. It has been estimated that > 325 different bacterial species may be found in plaque. Non-bacterial microorganisms found in plaque include mycoplasma species, yeasts, protozoa and viruses.

The intercellular matrix forms 20-30% of the plaque mass. It consists of organic and inorganic materials derived from saliva, gingival crevicular fluid and bacterial products.

Organic constituents of plaque:

- Polysaccharides
- Proteins
- Glycoproteins
- Lipid material

Mean generation time, that is the time taken for the bacteria to double their number on an average is about 3 hours. So one microorganism during the first 24 hours multiply to a total of 256 microorganisms.

Inorganic Constituents of Plaque

Calcium and phosphorous form the main inorganic constituents. Trace amounts of other minerals such as sodium, potassium and fluoride are also present. Source of inorganic constituents of supra gingival plaque is primarily saliva and that of sub gingival plaque is crevicular fluid.

Hypothesis concerning etiology of caries:

- i. Non-specific plaque hypothesis— says all plaque is cariogenic
- ii. Specific plaque hypothesis—recognizes plaque as pathogenic only when signs of associated disease are present.

Pathogenic Constituents of Plaque

- a. Substances producing/inducing direct tissue damage
For example, organic acids, ammonia, hydrogen sulfide, protease, collagenase, hyaluronidase, neuraminidase, etc
- b. Inflammation inducing substance
For example, chemotactic substances like polypeptide, activators of complement cascade, histamine, etc
- c. Substances inducing indirect tissue damage by host immunological response
For example, endotoxin, peptidoglycan, polysaccharide, bacterial antigen, etc.

Formation of Plaque

The process of plaque formation can be divided into 3 phases.

1. Formation of the pellicle coating on the tooth surface
2. Initial colonization by bacteria
3. Secondary colonization and plaque maturation.

Acquired pellicle is an acellular, essentially bacteria free film that deposits on the teeth soon after eruption. It is derived from components of saliva and crevicular fluid. It can be of 3 types globular, fibrillar and granular. Newly formed (2 hrs) pellicle is fairly uniform in thickness (100-700 nm).



Pellicle and its Structure

Pellicle functions as a protective barrier, providing lubrication for the surface, provide matrix for remineralization and preventing tissue dessication. But they also provide a substrate to which bacteria in the environment attach.

The pellicle has 3 distinct structures-

- i. The subsurface component – It extends below the surface of enamel, has a dendritic appearance due to the filling of pores and demineralized areas of enamel.
- ii. The surface component – It is closely associated with the surface of the tooth. Have uniform width of $<1 \mu\text{m}$.
- iii. The supra surface component – It is $1-10 \mu\text{m}$ wide, can be of uniform width or have a scalloped appearance.

Diet and Dental Caries

Improper dieting has been related to various systemic disorders like atherosclerotic diseases, C.V.S disorders, certain cancer and last but not the least in relation to our profession is the dental caries.

Caries is a multifactorial disease, diet being one of the factors favouring caries initiation and progression. Much has been written and discussed regarding the role of carbohydrates as the prime accused in the initiation of caries and is related to the type, frequency and mode of consumption.

Definition of Diet

“Diet refers to the customary allowance of food and drink taken by any person from day to day.”

Cariogenicity of a Food

The absolute cariogenic potential of food is influenced by many factors-

- A. Its fermentable carbohydrate content
- B. Cariostatic factors in food – includes protein (protect against demineralization and reduce the rate of crystal dissolution), fat (shown to reduce caries in rats), calcium, phosphate and fluoride, phytates in cereals and cocoa.

- C. Food retention – duration of presence of carbohydrate in oral cavity influence the period of time acid remains in contact with the tooth.
- D. Eating pattern - sequence of food intake is very important. The acid produced by eating pears or sucrose was neutralized if they were eaten with cheese or peanuts.
- E. Frequency – frequency of eating is also important and is found that in between meal snacking of carbohydrate containing food increases caries prevalence.
- F. Cooking and processing also will affect the carbohydrate portion of the food. Starch that undergoes heating and cooling cycles develops some resistance and a small percentage (2-5%) becomes resistant to amylase of saliva. At temperatures used for cooking, carbohydrates interact with proteins. This reduces the bioavailability of the sugar and aminoacids. Sucrose which is a nonreducing sugar does not react in this way.
- G. Other factors include detergent quality, texture, effect of mixing foods and pH of the food.

Food with Low Cariogenic Potential Would Have

- Relative high protein content
- Moderate fat content to facilitate oral clearance
- A minimal concentration of fermentable carbohydrates
- Strong buffering capacity
- High mineral content
- $\text{pH} > 6.0$
- Ability to stimulate salivary flow

Eating Habits in Children

The basic initial diet of a child depends on the diet of the family, the positive reinforcement of healthy diet by parents, socioeconomic condition, etc.

Children prefer food that is sweet and attractive to look. Preschooler may be very fussy about choosing the type of food and also they may find it difficult to adjust in the new environment when they are sent to baby sitters, day care centers etc. Their food habits may change from the routine home habits as they eat food from outside in the day time.



Television also plays an important role in affecting the likings of a child. Parents, teachers and caretakers must be educated about the kind of snack that is good for the child.

Family atmosphere especially at meal times also influences the dietary habit of a child. A friendly congenial atmosphere at meal times without threats will help the child attain a positive dietary practices.

An adolescent has adventurous lifestyles. They are more influenced by television, peers or idols and it is very difficult to convey messages and convince teenagers to accept them. One good thing about this age is that there is a strong desire to look attractive. Since mouth is the centre of the face, having good set of teeth is also important.

Dietary modification are definitely indicated in patients who have active lesions in the developing permanent dentition or had caries in primary dentition.

Role of Sugar in the Etiology of Caries

Sucrose has been labeled the arch criminal of dental caries. The extracellular polysaccharide produced by the bacteria utilizing sucrose, functions in a dual role as a structural matrix of the dental plaque and as a reservoir of substrate for the plaque organisms between meals. Some bacteria synthesize glucans, the polymers of glucose while others form levans from fructose. Biosynthesis of these polysaccharides occurs by the agency of extracellular enzymes which show a high specificity for sucrose. Patients on a soft protein- fat diet developed a thin structure less plaque after few days. When sucrose was included in the diet a striking difference in the appearance of the plaque became noticeable as it attained a considerable size and grew to form a voluminous and turgid mass.

The glucan is water insoluble, serves as structural components of plaque matrix to act as 'glue' for certain bacteria. The levan is water soluble and may be degraded by oral flora and may serve as transient reserves of fermentable carbohydrates, thus prolonging the duration of acid formation.

EPIDEMIOLOGICAL STUDIES RELATING SUCROSE TO DENTAL CARIES

There are many important epidemiological studies done to correlate diet and caries.

Some of the important studies are:

Vipeholm Studies

It was a 5 year study done in a mental institution in Sweden by Gustafsson et al from 1945-1953. The institution diet was nutritious which contained little sugar with no provision for between meal snacks. The dental caries rates in the inmates were relatively low.

The inmates were grouped into 7 groups as follows and caries incidence was compared:

1. Control group
2. Sucrose group – 300 gm initially and later 75 gm
3. Bread group – 345 gm, i.e. 50 gm of sugar
4. Chocolate group – 65 gm
5. Caramel group – 22 caramels, i.e. 70 gm of sugar
6. 8 toffee group – 6 gm of sugar
7. 24 toffee group – 120 gm of sugar.

Conclusion

- Increased carbohydrate mainly sugar increased caries
- Increased caries were seen when sugar is consumed in the form that will be retained on teeth surface
- In between meal snacks increased caries
- Caries activity varies widely
- Upon withdrawal of the sugar rich foods, the increased caries activity rapidly disappears
- Clearance time of the sugar correlated closely with caries activity.

Hope Wood House Study

It is the home for orphans in Australia. The children were brought up from infancy. They were on vegetarian diet with occasional serving of egg yolk. Sugar and other refined carbohydrates were excluded from the children's diet. The dental caries prevalence in young children in the primary dentition was almost negligible and that of permanent teeth was 1/10th of the average Australian child. Oral hygiene was extremely poor and about 75% had gingivitis. When these children left the institution and exposed to routine diet, there was a sharp rise in caries rate.

Hereditary Fructose Intolerance

This was first described in 1956. It is an autosomal recessive disorder of fructose metabolism associated with



reduced activity of the enzyme fructose-1-phosphate aldolase by 2-5% in liver, renal cortex and small bowel. This enzyme is required for the metabolism of fructose. Following fructose intake, the patient experiences nausea, vomiting, excessive sweating, malaise, tremor, coma and convulsions. Such patients tend to avoid all sweets, cakes, candies and most fruits. They eat glucose, galactose, lactose and starch containing foods. It has been noted that their teeth are in extraordinary good condition. Caries when present is limited to pits and fissures and is usually not found in smooth surface. The low caries prevalence indicates that starchy foods do not produce decay whereas sugary foods do.

Turku Sugar Studies

This was done to test the effects of chronic consumption of sucrose, fructose and xylitol on dental and general health. There was a dramatic reduction in caries incidence after 2 years of xylitol consumption. Fructose was found to be as cariogenic as sucrose for the first 12 months. Frequent inbetween meals chewing of xylitol gum produced anticariogenic effect.

PROTECTIVE FACTORS IN FOOD THAT HELP REDUCE CARIES

1. Phosphates
2. Glycyrrhizinic acid
3. Fats and protein
4. Trace elements

Phosphates

Different types of Phosphates that are Protective

- Inorganic phosphates-helps in remineralization or reduces dissolution and is a good buffer
- Trimetaphosphates is also protective
- Sodium metaphosphate appears to be the most effective.
- Calcium sucrose phosphate –by adsorbing on the tooth surface, it prevents enamel dissolution

- Organic phosphates (phytates, glycerophosphates) phytates –adsorb readily and firmly on enamel surface and prevent dissolution of enamel by acids.

Glycyrrhizinic Acid

It prevents caries by reducing enamel dissolution, inhibiting glycolysis and increasing plaque buffering power.

Fats and Protein

- Fats reduce the cariogenicity by providing a greasy layer. They also serve as anionic surfactant
- Proteins adsorb onto enamel surface and form a barrier
- Inclusion of milk solids reduced the cariogenicity of sugar containing foods.

Time

The time of contact between all the etiologic factors is the most crucial factor. If the food is washed off from the tooth surface through brushing, it is not available for the bacteria and thus reduces the risk of developing caries.

Trace Elements

Trace element in diet can be cariostatic or caries promoting. They are thus grouped into:

Cariostatic – F, P

Mildly cariostatic – Mo, V, Cu, Sr, B, Li, Au, Fe

Doubtful cariostatic – Be, Co, Mn, Sn, Zn, Br, I, Y

Caries inert – Ba, Al, Ni, Pd, Ti

Caries promoting – Se, Mg, Cd, Pt, Pb, Si

Trace elements are variously defined depending upon the field of chemical, physical, or biologic sciences being discussed. In the field of biology, elements that are present in only minute quantities in animal tissues are called trace elements, regardless of their abundance in nature.

The trace elements can be divided into two categories:

1. Those that have well-defined human requirements, namely, iron, zinc, iodine, copper and fluorine.
2. Those that are integral constituents or activators of enzymes, namely, manganese, molybdenum, selenium, chromium and cobalt.



Trace elements in dental enamel of permanent teeth

Concentration range ppm	Elements
> 1000	Na, Cl, Mg
100–1000	K, S, Zn, Is, Sr, F
10–100	Fe, Al, Pb, B, Ba
1–10	Cu, Rb, Br, Mo, Cd, I, Ti, Mn, Cr, Sn
0.1–0.9	Ni, Li, Ag, Ng, Sc, Be, Zr, Co, W, Sb, Hg
< 0.1	As, Cs, V, Au, La, Ce, Pr, Nd, Sm, Tb, Y
Not detected	Sc, Ga, Ge, Ru, Pb, In, Te, Eu, Gd, Dy Ho, Er, Tm, Lu, Hf, Ta, Re, Os, Ir, Pt, TI Bi, Rh

Possible Mechanism of Trace Element Action on Dental Caries

Effect of trace elements on dental caries is probably by altering the resistance of the tooth itself or by modifying the local environment at the plaque-tooth enamel interface. Like fluoride, other elements can modify the chemical and physical composition of the teeth thus affecting the solubility of the enamel to acid attacks.

The trace elements may also influence the microbial ecology of plaque to either inhibit or promote the growth of caries-producing bacteria.

MECHANISM OF DENTAL CARIES

Caries begins as a subsurface demineralization of the enamel which progresses along the enamel prisms to the DEJ, where the caries spreads laterally and centrally into the underlying dentin assuming a conical configuration with the apex towards the pulp.

Various theories put forward to explain the mechanism of caries are as follows:

1. *Worms*—According to ancient Sumerian text, tooth ache was caused by a worm that drank the blood of the teeth and fed on the roots of the jaws – 5000 BC.
2. *Humors*—Persons physical and mental constitution was determined by 4 elemental fluids- blood, phlegm, black bile and yellow bile corresponding to 4 humors – sanguine, phlegmatic, melancholic and choleric. Diseases could be explained by an imbalance of these humors.
3. *Endogenous/vital theory*—Regards dental caries as originating within the tooth itself.

4. *Chemical theory*—Parmly said that a chemical agent was responsible. Foods putrified on tooth surface and dissolved the tooth material – 1819
5. *Parasitic/septic theory*—According to Erdl (1843) there are filamental parasites on the surface membrane of the teeth. Ficus called them denticolae.
6. *Sucrose chelation theory*—According to Eggers and Lura, sucrose itself causes enamel dissolution by forming unionized calcium saccharates, which requires inorganic phosphate.
7. *Glycogen theory*—According to Egyedi, susceptibility to caries is related to a high carbohydrate intake during the period of tooth development, resulting in the deposition of excess glycogen and glycoprotein in tooth structure which are inturn degraded to acids by plaque bacteria.
8. *Organotrophic theory, by Leimgruber*—It states that caries is a disease of the entire dental organ.
9. *Biophysical theory, (Neumann and Disalvo)*.
10. *Autoimmune theory, (Burch and Jackson)*—According to which the genes determine the caries susceptibility of tooth.
11. *Acidogenic/chemicoparasitic theory*—(Miller 1882), Described dental decay as a chemicoparasitic disease consisting of two distinctly marked stages – the decalcification and dissolution. The acid formed is recognized as lactic acid.
12. *Proteolytic theory*—(Gottlieb, 1944)
Described enamel matrix as the key to caries formation, involving protein splitting micro-organisms followed by physical and or acid dissolution of the inorganic salts
13. *Proteolysis chelation theory, (Schwartz and Martin 1955)*—involves 2 interrelated simultaneously occuring reactions
 - Microbial destruction of the largely proteinaceous organic matrix
 - Loss of apatite through dissolution by organic chelators

Substances having chelating properties are peptides, aminoacids, citrate, lactate,

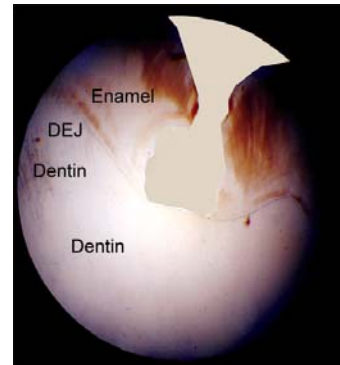


hydroxyesters, ketoesters, polyphosphates, carbohydrates, etc.

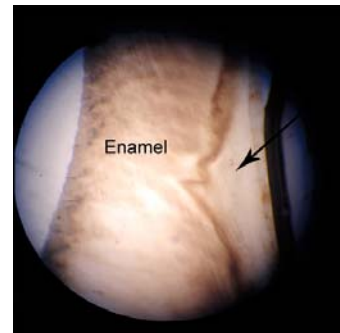
14. Theory of demineralization and remineralization: Caries is actually the combined process of demineralization and remineralization. If the process of demineralization exceeds at a faster rate than that of remineralization, it results in the formation of caries. Demineralization is due to the acids especially the lactic acid produced by the bacteria as the end product of carbohydrate metabolism. Remineralization is due to the precipitation of minerals especially calcium and phosphates present in the saliva and this precipitation is hastened by the presence of fluoride.

Stephan curve — Within 2-4 minutes of rinsing with a solution of glucose or sucrose, plaque pH is reduced from about 6.5 to 5.0 and gradually returns to original value within 40 minutes. This when graphically plotted is the curve called as Stephan curve.

this surface zone is in an equilibrium with mineral being lost into the plaque due to low pH but being remineralized from the ions diffusing out from the subsurface lesion. If the cariogenic environment continues, eventually the rate of transfer from the surface enamel into plaque becomes greater than the rate of precipitation and the surface enamel collapses leading to cavity.



A



B

Figs 11.6A and B: Ground section of enamel caries; A: Pit and Fissure Caries; B: Smooth surface caries

MICROSCOPIC STRUCTURE (FIG. 11.6)

Enamel Caries

The microscopic structure of enamel caries are divided into 4 zones

Zone 1—Translucent zone seen at the advancing front of the lesion

Zone 2—Dark zone (positive zone), lie deep to the area of visible radiolucency

Zone 3—Body of the lesion, area of greatest demineralization, and forms largest portion of carious enamel

Zone 4—Surface zone, that is relatively unaffected layer. It is radiopaque, due to partial demineralization may be present which can be explained by “Moreno Model”

Moreno Model—According to this model, bacterial acids dissolve the surface as well as the subsurface enamel. The calcium and phosphate ions produced from the subsurface dissolution diffuse outward toward the surface and reprecipitate on the surface, making the enamel surface appear unaltered. Thus,

The Microscopic Structure of Dentinal Caries (Fig. 11.7)

- On reaching the dentin, the carious lesion spreads laterally along the dentinoenamel junction often undermining the enamel, following the direction of dentinal tubules. The resulting lesion is cone shaped with base at DEJ and apex towards the pulp.
- Affected dentin displays different degrees of discoloration from brown to dark brown or almost black.

**Zones from lesion to normal dentin**

- Decomposed dentin
- Bacterial invasion
- Demineralization
- Dentinal sclerosis
- Fatty degeneration

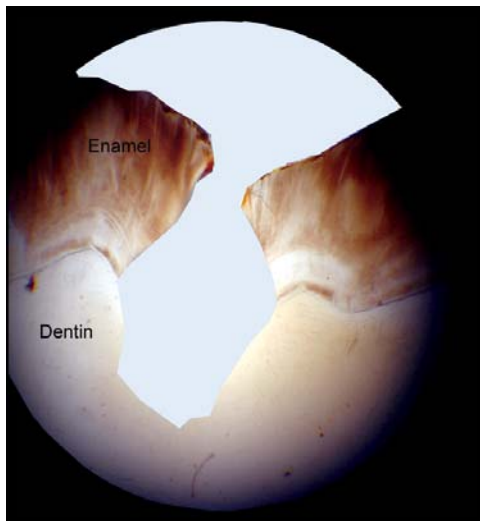


Fig. 11.7: Ground section of caries extending into dentin

AREA SUSCEPTIBILITY FOR CARIES

The caries involvement in primary dentition is as follows:

- Mandibular molars, maxillary molars and maxillary anteriors are commonly involved. Mandibular incisors are affected only in rampant caries.
- Mandibular posterior teeth are more susceptible than their maxillary counterparts.
- First molar is less susceptible than second molar.
- By 8 yrs – 50% of second molar and 20% of first molar would have occlusal caries.
- Interproximal caries usually develops after the proximal contacts develop.
- Proximal caries progress more rapidly than occlusal caries and causes a higher percentage of pulp exposures.

Surface by Surface Comparison of the Teeth

Tooth	Maxilla	Mandible
Second molar	Occlusal+palatal	Occlusal+buccal
First molar	Occlusal	Occlusal+buccal
Canine	Buccal	Buccal
Incisors	Mesial	Not commonly involved

The caries involvement in mixed dentition is as follows:

- First permanent molars are at high risk for development of caries as soon as they erupt.
- It is found that by 7yrs, 25% of mandibular I molar had caries on the occlusal surface, 12% of maxillary I molar had occlusal caries. By 9 yrs 50% had caries in mandibular I molar and 35% in maxillary I molar. By 12 yrs, 70% had caries in mandibular I molar and 52% in maxillary I molar.
- The distal surface of deciduous second molar is a common site for caries, after the eruption of the first permanent molar.
- At 8 yrs, approximately 1% of the maxillary incisors will be carious and by 12yrs, 15% of them will be carious.

The caries involvement in permanent dentition is as follows:

- Rise in caries attack rate continues with the eruption of the second permanent molars and premolars.
- Mandibular II molars are at high risk for occlusal surface caries compared to the maxilla.
- The buccal groove in the mandibular molar and palatal groove in the maxillary molars are sites for morphologic defects and incomplete enamel formation.

CLASSIFICATION OF CARIES

- Based on the location
 - Pit and fissure caries
 - Smooth surface caries
- Based on the severity
 - Acute caries
 - Chronic caries
 - Arrested caries
- Based on the extension
 - Enamel caries: Caries limited to enamel
 - Dental caries: Caries extending to dentin
 - Root caries: Usually not seen in children
- Based on chronology
 - Early childhood caries such as nursing bottle caries
 - Teenage caries such as rampant caries
 - Adult caries such as root caries which is common in adults



- Based on the origin
 - Primary [virgin] caries
 - Secondary [recurrent] caries

Enamel Caries—Early Features

- Small opaque white region, called as ‘white spot’ (Fig. 11.8) forms the initial feature. This is the zone of demineralization that can be remineralized.
- Enamel overlying this white spot is hard and shiny with no morphologic changes from the sound enamel.
- It may also appear brownish – ‘brown spot lesion’ and the discoloration is due to exogenous stain.
- Associated with accentuated incremental stria of retzius.

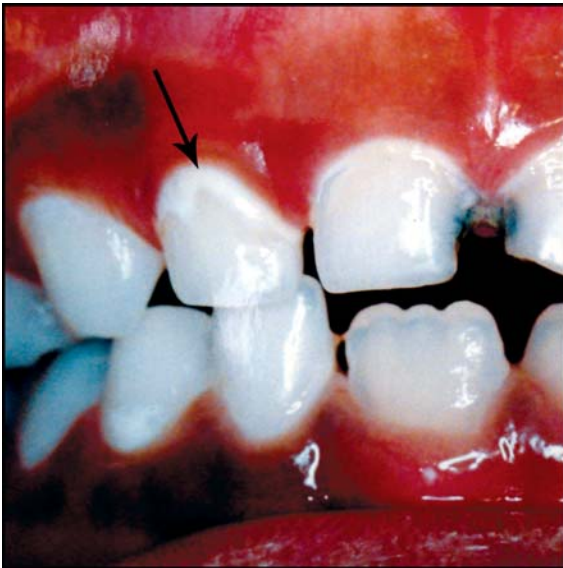


Fig. 11.8: Opaque white area seen on the cervical border of upper lateral incisor indicating early caries

Pit or Fissure Caries (Fig. 11.9)

- Pit or fissure caries develops in the occlusal surface of molars and premolars, in the buccal and lingual surface of the molars and in the lingual surfaces of the maxillary incisors.
- Carious lesion more often starts at both sides of the fissure wall, penetrating nearly perpendicular towards the DEJ. Enamel rods flare laterally in the bottom of the pit where caries follows the direction of enamel rods, characteristic triangular shaped base directed towards the dentin.
- Pits or fissures with high steep walls and narrow bases are those most prone to develop caries.
- They favor the retention of food debris and micro organisms and caries may result from fermentation of this food and formation of acids.
- Pits and fissures affected by early caries may appear brown or black and will feel slightly soft and “catch” a fine explorer point.
- The enamel bordering the pit or fissure may appear opaque bluish white as it becomes undermined. This undermining occurs through lateral spread of the caries at the DEJ. Thus, there may be a large carious lesion with only a tiny point of opening.



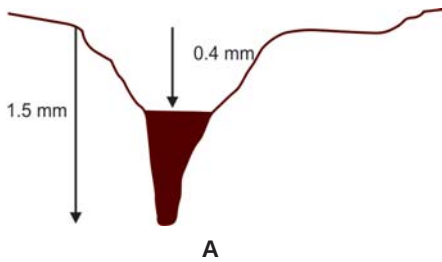
Fig. 11.9: Caries on the pits and fissures of posterior teeth

Classification of fissures (Figs 11.10A and B)

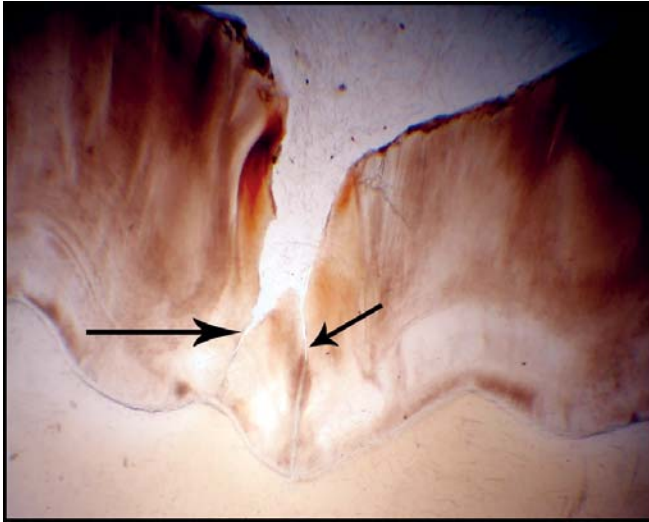
1. V' type – 34%
2. U' type – 14%
3. I' type – 19% -narrow slit
4. IK' type – 26% - narrow slit with larger space at the bottom
5. Other types – 7%- inverted Y

Smooth Surface Caries (Fig. 11.11)

- Smooth surface caries develops on the proximal surfaces of the teeth or on the gingival third of the buccal and lingual surfaces.
- Smooth surface caries is generally preceded by the formation of a microbial or dental plaque.



A



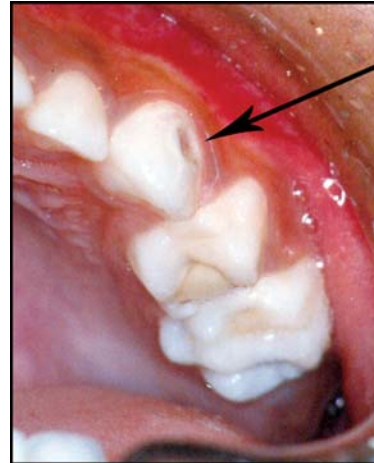
B

Figs 11.10A and B: Normal Fissure;

- A: Diagrammatic representation of a deep fissure
- Total depth of the fissure: 1.5 mm
 - Depth to which a bristle can reach (Arrow): 0.4 mm
 - Depth of the fissure that cannot be cleaned (Darkened area): 1.1 mm;
- B: Ground section of the normal fissure. Arrows indicating the narrow fissures bifurcating into a inverted Y' shaped deep fissure

- Proximal caries usually begins just below the contact point and appears in the early stage as a faint white opacity of the enamel without apparent loss of continuity of the enamel surface.
- The early white chalky spot becomes slightly roughened, owing to superficial decalcification of the enamel.
- As the caries penetrates the enamel, the enamel surrounding the lesion assumes a bluish white appearance. This is particularly apparent as lateral spread of caries at the DEJ occurs.
- Cervical caries usually extends from the area opposite the gingival crest occlusally to the convexity of the

tooth surface. Thus the typical cervical carious lesion is a crescent shaped cavity beginning as a slightly roughened chalk area which gradually becomes excavated.



A



B

Figs 11.11A and B: Smooth surface caries; A: Seen on the labial surface of lateral incisor; B: Involving the proximal surface of central incisors

Acute Dental Caries (Fig. 11.12)

- It is that form of caries which runs a rapid clinical course and results in early pulp involvement by the carious process.
- The process is so rapid that there is little time for the deposition of secondary dentin.
- The dentin is usually stained a light yellow.
- Nursing bottle and rampant caries are a type of acute caries that is fast spreading.



Fig. 11.12: Acute dental caries

Chronic Dental Caries (Fig. 11.13)

- It is that form of caries which progresses slowly and tends to involve the pulp much later than acute caries.
- The slow progress of the lesion allows sufficient time for deposition of secondary dentin in response to the adverse irritation.
- The carious dentin often stains deep brown.
- The cavity is generally a shallow one with a minimum softening of dentin.
- There is little undermining of enamel and pain is not a common feature.

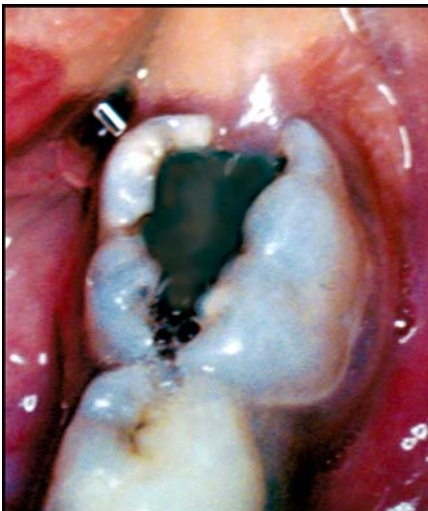


Fig. 11.13: Chronic dental caries

Recurrent Caries

- It is that type of caries that occurs in the immediate vicinity of a restoration.

- It is usually due to inadequate extension of the original restoration, which favors retention of debris or to poor adaptation of the filling material to the cavity which produces a leaky margin.
- The renewed caries follows the same general pattern as primary caries.

Arrested Caries (Fig. 11.14)

- It has been described as caries which becomes static or stationary and does not show any tendency for further progression.
- It occurs almost exclusively in caries of occlusal surfaces and is characterized by a large open cavity in which there is lack of food retention and in which, the superficially softened and decalcified dentin is gradually burnished until it takes on a brown stained, polished appearance and is hard. This has been referred to as "Eburation of dentin".
- Another form of arrested caries is that sometimes seen on the proximal surfaces of teeth in cases in which the adjacent approximating tooth has been extracted.



Fig. 11.14: Arrested caries

Rampant Caries

Rampant caries or fast spreading caries in children is very common but most difficult to treat. Abnormal feeding habits form the major reason for the development of acute caries in children and various



terms have been used to describe this such as Nursing caries, Nursing bottle syndrome, Baby bottle tooth decay to early childhood caries. Recently Maternally Derived Streptococcus Mutans Disease (MDSMD) has also been used to describe childhood caries.

Definition

According to massler (1945): “Rampant caries is defined as suddenly appearing, widespread, rapidly burrowing type of caries, resulting in early involvement of pulp and affecting those teeth usually regarded as immune to ordinary decay.”

According to winter (1966): “Rampant caries are caries of acute onset involving many or all of the teeth in areas that are usually not susceptible and are associated with rapid destruction of the crowns with frequent involvement of the dental pulp.”

Etiology

- The main cause is inadequate maintenance of oral hygiene.
- Emotional disturbance has also been linked as the causative factor. Emotional disturbance may initiate an abnormal craving for sweets and the habits of snacking which in turn might influence the incidence of dental caries.
- Noticeable salivary deficiency is also common in tense, nervous or disturbed persons, all these leading to the development of rampant caries.
- It is also attributable to primary and secondary nutritional inadequacies.

Feature of Rampant Caries (Fig. 11.15)

- Involvement of proximal surface of the lower anterior teeth and development of cervical type of caries is very characteristic.
- Typical rampant caries cases in adolescent are characterized by buccal and lingual caries of premolar and molars, proximal and labial caries of upper incisors and proximal caries of lower incisors.
- In both the primary and permanent dentition decalcification of enamel appears as broad bands encircling the teeth.

Management of Rampant Caries (Figs 11.16A & B)

A comprehensive treatment planning should be instituted, that is aimed at

- Control of active carious lesion- by gross caries removal followed by temporary restoration
- Diet assessment and counseling when needed
- Oral hygiene instructions
- Home and professional fluoride treatment
- Longitudinal monitoring of *S. mutans* level.



Fig. 11.15: Rampant caries



A



B

Figs 11.16A and B: Rampant caries and its management; A: Pre treatment; B: Post treatment



Nursing Bottle Caries/Baby Bottle Caries

Definition

Kroll (1967): “a syndrome characterized by a severe caries pattern beginning with the maxillary anterior teeth in a healthy bottle fed infant or a toddler.”

- It is a type of rampant caries the cause being prolonged bottle feeding
- Usually seen in 2-4 year age group
- Early caries involvement of the maxillary anterior teeth, the maxillary and mandibular posterior teeth and mandibular canines is seen
- Mandibular incisors are unaffected due to the protection by the tongue (Fig. 11.17)



Fig. 11.17: Nursing bottle caries. Note that the lower incisors are not involved in nursing bottle caries

- Seen as white or dark brown collar of caries around the neck of the incisors, which develops into faciolingual caries and may also fracture the tooth
- The main etiology is that the child is put to bed with a nursing bottle containing milk or sugar containing

beverages. The child falls asleep and the milk or sweetened liquid becomes pooled around the maxillary anterior teeth. This provides an excellent culture medium for acidogenic microorganisms. Salivary flow is reduced during sleep and clearance of the liquid from the oral cavity is slowed.

- It is recommended that the infant be held while feeding. The child who falls asleep while nursing should be woken up, burped, mouth washed and then placed in bed. In addition the parents should start brushing the child's teeth as soon as they erupt and discontinue nursing bottles as soon as the child can drink from a cup i.e at approximately 12-15 months of age.
- Management includes parent counseling, provisional restorations, diet assessment, caries activity tests, constant re-evaluations, fluoride therapy followed by restorations and recall once in 2-3 months.

Stages in the Development of Nursing Bottle Caries

Stage	Age (month)	Clinical appearance
Initial	10 - 20	Maxillary anterior teeth – Opaque white demineralization in the cervical or interproximal region
Damaged	16 - 24	Maxillary anterior teeth – Yellow - brown discoloration. Cervical or interproximal superficial defects Maxillary first molars– will be in first stage
Deep lesions	20 - 36	Maxillary anterior teeth – marked enamel defect and pulpal irritation Maxillary first molars are in second stage Mandibular first molars are in first stage
Traumatic	30 - 48	Maxillary anterior teeth – loss of large enamel or dentin parts, crown fractures Maxillary first molars are in third stage Mandibular first molars are in second stage

Fluoride treatment for children with rampant caries [0.3 - 0.7 ppm water F level]

[As per Council on Dental Therapeutics of ADA, 1986].

Age	0-2 Years	2-3 Years	3-13 Years	>13 Years
Dietary supplement	Not required	0.25 mg daily	0.5 mg daily	Not indicated
Professionally Applied Topical Fluoride	APF solution or gel applied 4 times a year	APF solution or gel applied 4 times a year	APF solution or gel applied 4 times a year	APF solution or gel applied 4 times a year
Self Applied Fluoride	Not required	Not required	Self application of gel in a tray daily for approximately 4 weeks thereafter continue with daily fluoride rinse (0.05% NaF)	

**Treatment Protocol for Early Childhood Caries****1. PREVENTIVE CARE****Professional Care**

- Educating parents regarding importance of deciduous teeth
- Diet counseling
- Dental health education to parents regarding gum pads cleaning, tooth brushing, frequent mouth rinsing
- Advocating fluoride supplementation if needed
- Advocating fluoride containing dentifrices once a day only after four years of age
- Applying fluoride varnish topically
- Application of fissure sealants in first and second primary molars
- Regular recalls for routine monitoring for dental health
- Reinforcing and motivating parents to continue supervised home care

Home Care

- Elimination of cariogenic food items from the diet
- Substitution with tooth friendly food
- Discouraging bottle feeding at night
- Falling asleep with pacifiers should be stopped

- Cleaning of gumpads during -infancy period is encouraged
- Digital or baby tooth brushing as the teeth erupts
- Initiating mouth rinsing habit after consuming any solid or drinks
- Regular visit to dental clinic once in six months

2. RESTORATIVE**Incipient or White Spot Carious Lesions**

- Professional topical fluoride application and observation of the lesion for reversal
- Fissure sealant application

Carious Lesions in Enamel and Dentin

- Preventive resin restoration
- Glass ionomer fillings
- Composite restoration in anterior teeth
- Posterior composite restoration
- Amalgam restoration in posterior teeth
- Nickel chrome stainless steel crowns
- Anterior and posterior crown restorations

Carious Lesions With Pulp Involvement

- Pulp therapy with full coverage coronal restoration
- Extraction with space management

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Chapter 12



Pediatric Operative Dentistry

1. Introduction
2. Features of Deciduous Teeth Compared to Permanent Teeth
3. Diagnosis of Caries
4. Cavity Preparation and Classification
5. Amalgam Restoration for Primary Teeth
6. Matrix Bands, Retainers and Wedges
7. Isolation Techniques
8. Silver Amalgam Restorative Material
9. Glass Ionomer Restorative Material
10. Composite Resin Restorative Material



INTRODUCTION

The aim of pediatric operative dentistry is to maintain the tooth in the dental arch in a healthy state, so as to prevent its loss and the development of subsequent problems.

It is important to understand the difference in structure between the deciduous and permanent teeth before planning any procedure.

FEATURES OF DECIDUOUS TEETH COMPARED TO PERMANENT TEETH

1. **Shorter crown:** The total height of the clinical crown of the deciduous tooth is less and hence the depth of the cavity should be similarly less. The mesial pulp horns extend higher occlusally than on permanent teeth, and thus risk for accidental exposure increases during cavity preparation.
2. **Narrow occlusal table (Fig. 12.1):** The occlusal table width of deciduous molars are very narrow compared to the permanent molar as presented in the figure. Accordingly the width of the cavity should also be less in a deciduous tooth.
3. **Constricted cervical portion (Figs 12.2 and 12.3):** The deciduous teeth are characterized by a prominent cervical ridge more pronounced on the buccal aspect and a steep cervical constriction cervical to the ridge. Care must be taken while preparing the proximal box, as there is risk of pulp exposure at the site of constriction. Class II cavity should be restored with proper placement of wedges at the constricted area so that the matrix band is adapted well to the tooth surface.
4. **Thinner enamel and dentin layers:** Enamel and dentin is much thinner, thus dental caries penetrates deeper to reach the pulp earlier in primary teeth. Care must be taken during cavity preparation, not to extend very deep as there is increased chance of pulp exposure.
5. **Enamel rods extend in a slightly occlusal direction from the DEJ in the gingival third (Fig. 12.4):** So enamel beveling at the gingivocavo surface line angle is not required, as no enamel rods remain unsupported.
6. **Broad and flat contact areas (Fig. 12.5):** Caries may remain undetected. The proximal box preparation may have to be extended widely to break the contact free. CI II cavity.
7. **Wider mesiodistally than cervico-occlusal height:** This is important during the selection of the stainless steel crown.
8. **Lighter color:** Deciduous teeth are generally lighter or whiter in color compared to the permanent teeth. This has to be kept in mind during shade selection for composite restoration or crown restorations.

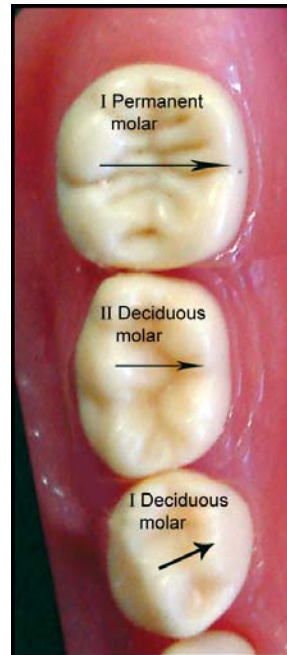


Fig. 12.1: The occlusal table of the deciduous molars is narrower compared to the permanent molar



Fig. 12.2: Note the presence of cervical constriction apical to the cervical ridge



Fig. 12.3: The position of the wedge to hold the matrix band in close approximation to the tooth surface

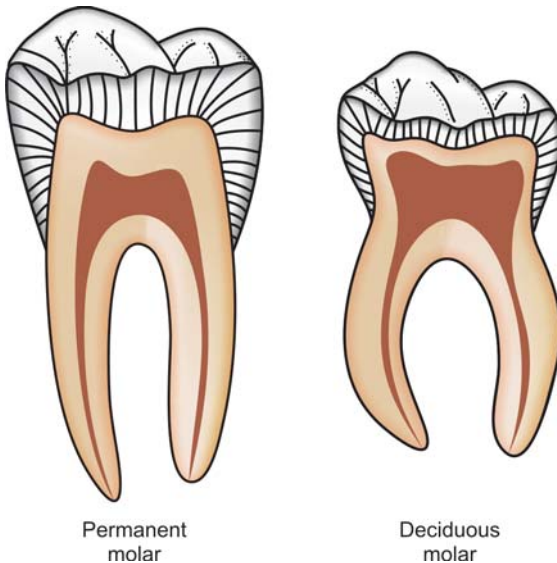


Fig. 12.4: Note the occlusal direction of the enamel rods at the cervical portion in deciduous tooth



Fig. 12.5: Dark circle representing the broad and wide contact area in the deciduous tooth

Treatment decisions for pit and fissure caries and smooth surface caries

Caries unlikely	→	No treatment
Noncavitated	→	
Caries likely	→	Sealant and minimal intervention techniques
Cavitated	→	Restoration and topical fluoride therapy

DIAGNOSIS OF CARIES

Identifying caries at its early stage (preferably at the precavitation stage) is very essential to prevent significant tooth destruction.

A variety of diagnostic methods are available to detect caries activity at early stages.

1. Identification of subsurface demineralization—Inspection, radiographic and dye uptake, infrared laser fluorescence (Diagnodent), digital imaging, Fiberoptic transillumination, quantitative Light fluorescence etc.
2. Bacterial testing.
3. Assessments of environmental conditions like pH, salivary flow and salivary buffering.

Since no single test has been developed that is 100% predictive of later development of cavitated lesions, a concept of caries risk has been promoted. Once detected, patients at high risk for caries can be treated with preventive methods that reduce their likelihood of developing cavitated lesions in the future.

Cavitated Lesions can be Detected as Follows

Visual Evidence

The teeth are examined with good illumination, tooth separators or transillumination for the presence of:

- *Opacification:* Due to demineralization in the subsurface of the enamel, initial caries appears as chalky white or opaque area without any loss of tooth structure. Care should be taken not to apply pressure with any instrument as there is risk of puncturing the surface enamel.
- *Surface roughness:* The roughness can be also confirmed by passing the explorer lightly over the surface.



- *Discoloration:* Subsurface discoloration without the presence of detectable cavity especially on the pits and fissures of the occlusal surface of the molars.
- *Cavitation:* Diagnosis of an obvious cavity does not require any extra armamentarium.

Tactile Evidence

By the use of sharp explorers, for the feel of

- Roughness
- Softening

Disadvantages of using sharp explorer are:

- Immature pits may break
- Spread of caries (inoculating loop)

“Catch” may also depend upon:

- Shape of the fissure
- Sharpness of the explorer
- Force of application

Newer Methods of Caries Diagnosis

1. Infrared laser fluorescence (Diagnodent)
2. Digital imaging fiberoptic transillumination
3. Quantitative light fluorescence.

Infrared Laser Fluorescence (Diagnodent)

It helps in the detection and quantification of occlusal and smooth surface caries. It uses a diode laser light source and a fibreoptic cable that transmits the light to a hand held probe with a fiberoptic eye at the tip. The light is absorbed and induces infrared fluorescence by organic and inorganic materials. The emitted fluorescence is collected at the probe tip and transmitted, processed and presented on a display window as an integer between 0 and 99. Increased fluorescence reflects carious tooth substance (numerical value higher than about 20).

Digital Imaging Fiberoptic Transillumination (DIFOTI)

It is similar to FOTI (Fiberoptic Transillumination) that has been used for caries detection in dentistry since many years. The difference here in DIFOTI is that the images are visually observed using a digital charged coupled device (CCD) camera and computer.

Quantitative Light Fluorescence (QLF)

It consists of a small portable system in which laser source is used. The light illuminating the tooth is transported through a liquid-filled light guide. The fluorescent filtered images are captured using a color CCD camera. Data collected is stored and analyzed on a computer.

CAVITY PREPARATION

Definition

Cavity preparation is defined as the mechanical alteration of a defective, injured or diseased tooth in order to best receive a restorative material which will reestablish a healthy state of the tooth including esthetic corrections where indicated, along with normal form and function.

Objectives

1. All the defects must be removed and the pulp must be adequately protected.
2. The margins should be as conservatively located as possible.
3. The form of the cavity should be such that the restoration should not get displaced and the tooth or the restoration should not fracture under the force of mastication.
4. The restorative material that is used should be esthetic and functional.

Factors to be Considered Before Cavity Preparation

1. Type of restorative material to be placed
2. Direction of the enamel rods
3. Support for the enamel rods
4. Location of the margins
5. Degree of smoothness desired

General Principles of Cavity Preparation for Silver Amalgam:

Initial cavity preparation stage:

Step 1: Outline form and initial depth

Step 2: Primary resistance form

Step 3: Primary retention form

Step 4: Convenience form



Final cavity preparation stage:

- Step 5: Removal of any remaining enamel pit/fissure, and /or infected dentin, and/or old restorative material if indicated
- Step 6: Pulp protection
- Step 7: Secondary resistance and retention forms
- Step 8: Procedures for finishing external walls
- Step 9: Final procedures: cleaning; inspecting; varnishing; conditioning.

CAVITY CLASSIFICATION

Black's Classification

Class I (Figs 12.6A to C): Cavities on occlusal surface of premolars and molars: cavities on occlusal 2/3 of the facial and lingual surfaces of molar: cavities on lingual surface of maxillary incisors.

General Cavity Preparation for Glass Ionomer Restoration:

- Step 1: Outline form
- Step 2: Convenience form to allow complete caries removal and placement of restorative material
- Step 3: Cavity extension and depth is limited to the extension of caries
- Step 4: Removal of unsupported enamel and deep caries
- Step 5: Pulp protection
- Step 6: Dentin conditioning
- Step 7: Restoration of the cavity with Glass Ionomer Cement
- Step 8: Cleaning; inspecting; varnishing; conditioning

Class II (Fig. 12.7): Cavities on the proximal surfaces of posterior teeth.

Class III (Fig. 12.8): Cavities on the proximal surfaces of anterior teeth that do not involve the incisal angle.

Class IV (Fig. 12.9): Cavities on the proximal surfaces of anterior teeth that do involve the incisal edge.

Class V (Fig. 12.10): Cavities on the gingival third of the facial or lingual surface of all teeth.

Class VI (Fig. 12.11): (Modified by Simon) Cavities on the incisal edge of anterior teeth or occlusal cusp heights of posterior teeth.



A



B



C

Figs 12.6A to C: Class I cavities-involving the; A: Occlusal surface of posterior teeth; B: Occlusal 2/3 of the facial and lingual surfaces of molar; C: Lingual surface of maxillary incisors



Fig. 12.7: Class II cavities involving the proximal surface of the posterior teeth



Fig. 12.8: Class III cavities involving the proximal surface of the anterior teeth without involving incisal edge



Fig. 12.9: Class IV cavities involving the proximal surface of the anterior teeth with the involvement of the incisal edge



Fig. 12.10: Class V cavities involving the gingival third of the facial or lingual surface of all teeth



Fig. 12.11: Class VI cavities involving the incisal edge of anterior teeth or occlusal cusp heights of posterior teeth

Finn's Modification of Black's Classification for Deciduous Teeth

Class I: Cavities on the pits and fissures of the molar teeth and the buccal and lingual pits of all teeth.

Class II: Cavities on the proximal surfaces of molar teeth with access established from the occlusal surface (Fig. 12.12).

Class III: Cavities on the proximal surfaces of anterior teeth that may or may not involve the labial or lingual surface (Fig. 12.13).

Class IV: Cavities on the proximal surfaces of anterior teeth that do involve the incisal edge.

Class V: Cavities on the cervical third of all the teeth including the proximal surface where the marginal ridge is not included.

Class VI: (Modified by Simon) Cavities on the incisal edge of anterior teeth or occlusal cusp heights of posterior teeth.

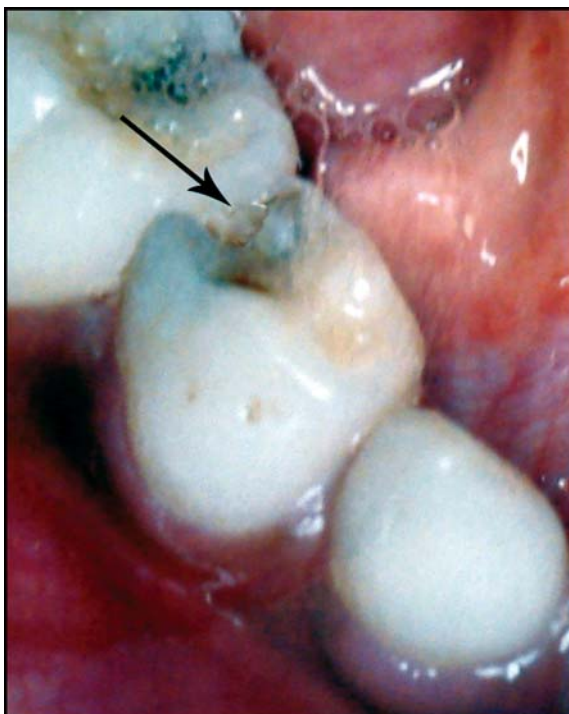


Fig. 12.12: Cavities on the proximal surfaces of molar teeth with access established from the occlusal surface



Fig. 12.13: Class III cavities on the proximal surfaces of anterior teeth that is extending to involve the labial and lingual surface

Classification by Mount and Hume (1998)

In this classification the cavity is defined based on the site of occurrence and the size of the cavity and numbers are allotted, as follows:

Classification based on the Site of Occurrence of Carious Lesions

Site 1: Cavities seen in the pits, fissures and enamel defects of the occlusal surfaces of posterior teeth or other smooth surface that do not belong to site 2 or 3.

Site 2: Cavities seen on the proximal enamel immediately below areas in contact with adjacent teeth.

Site 3: Cavities seen on the cervical one-third of the crown or the root if they are exposed.

Classification based on the Size of Carious Lesions

Size 1: Minimal involvement of dentin that cannot be treated by remineralization alone.

Size 2: Moderate involvement of dentin. The amount of enamel remaining following cavity preparation is sound, well supported by dentin and not likely to fail under normal occlusal load. The remaining tooth structure is sufficiently strong to support the restoration.

Size 3: The cavity is enlarged beyond moderate. The remaining tooth structure is weakened extensively that cusps or incisal edges are split, or are likely to fail or left exposed to occlusal or incisal load. The cavity needs to be further enlarged so that the restoration can be designed to provide support and protection to the remaining tooth structure. Extensive caries with bulk loss of tooth structure has already occurred.

Site	Size			
	Minimal 1	Moderate 2	Enlarged 3	Extensive 4
1. Pit and fissure	1.1	1.2	1.3	1.4
2. Contact area	2.1	2.2	2.3	2.4
3. Cervical	3.1	3.2	3.3	3.4

AMALGAM RESTORATION FOR PRIMARY TEETH

Important points to be remembered while preparing a cavity for amalgam restoration are:



Occlusal (Fig. 12.14)

1. Outline form should include all fissures, areas of caries, pits and developmental grooves and should be dovetailed.
2. The extension of the occlusal portion of the cavity preparation depends on the primary molar involved:
 - a. The occlusal portion usually is extended about one half the way across on the primary maxillary and mandibular first molars
 - b. For the primary mandibular second molar, extend the step completely across the occlusal surface
 - c. The primary maxillary second molar preparation includes only the nearest occlusal pit. The oblique ridge is not included unless undermined with carious lesions (Fig. 12.15).
3. The walls converge slightly with the greatest width at the pulpal floor (Fig. 12.16)
4. Cavo-surface margins should be sharp
5. Angles of walls and floors should be slightly rounded
6. Isthmus width should be one-third the width of the occlusal table
7. Depth of the cavity – 0.2-0.8 mm into the dentin.

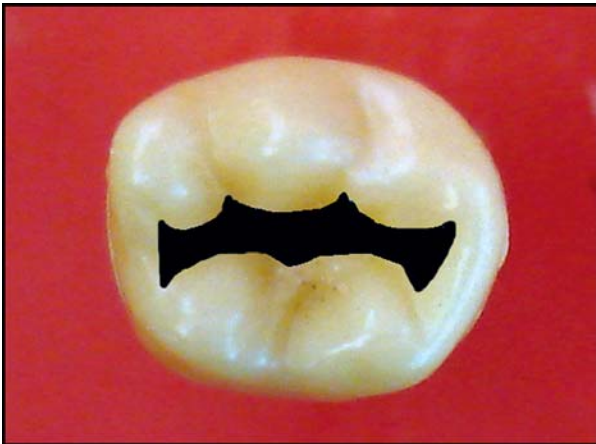


Fig. 12.14: Outline of the occlusal cavity should include all fissures, areas of caries, pits and should be dovetailed

Proximal Box

1. The axiopulpal line angle should be gently rounded
2. The buccal and lingual walls should just extend into self-cleansing areas
3. A sharp 90° cavo-surface angle is desirable
4. The buccal and lingual walls of the proximal box should converge slightly from the gingival floor to the occlusal surface (Fig. 12.17)
5. The gingival floor should be beneath the point of contact, at or just beneath the gingival tissue. No bevel is placed
6. All internal line angles should be gently rounded
7. Buccal and lingual retentive grooves are contraindicated
8. The axial wall should follow the contour of the tooth



Fig. 12.15: Occlusal cavity preparation on a maxillary second molar does not cross the oblique ridge

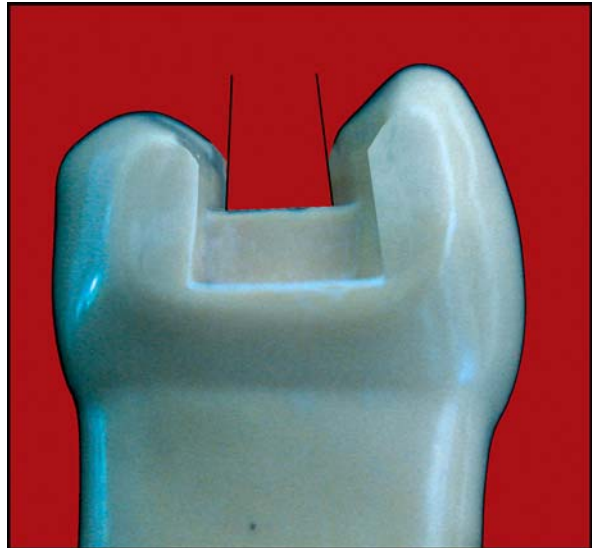


Fig. 12.16: The cavity wall should converge occlusally to provide retention to the restoration as seen from the proximal aspect



9. The isthmus is approximately one-half to one-third the width of the occlusal surface.

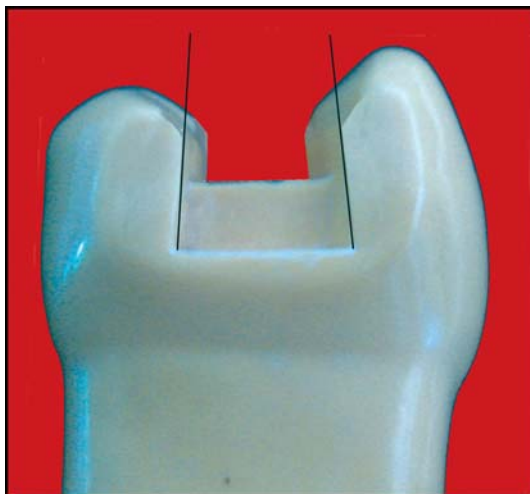


Fig. 12.17: The buccal and lingual walls of the proximal box should converge slightly from the gingival floor to the occlusal surface

CONSERVATIVE APPROACH FOR PROXIMAL CARIES IN DECIDUOUS TEETH

Tunnel Preparation

It is a type of cavity preparation made when the caries is located in the proximal surface, more than 2.5 mm from the marginal ridge. The proximal surface is reached from the triangular fossa in the occlusal surface without cutting the marginal ridge. Thus, a tunnel is formed keeping the marginal ridge intact.

Slot Preparation

This type cavity preparation is also done for proximal caries. The cavity outline is like a box with no step such as for gingival seat.

Proximal Approach

This type cavity preparation is done when there is proximal caries and no adjacent teeth are present. So there is direct visualization of caries and also cavity preparation is directly done approaching from the proximal surface itself.

MATRIX BANDS, RETAINERS AND WEDGES

Matrix bands replace the missing proximal surface of the tooth. Retainers are used to hold the bands in place. Wedges are used to adapt the matrix band closely to the tooth surface especially at the cervical constriction and thereby preventing any extension of material into the gingival tissue during condensation of the amalgam in a class II cavity preparation.

Classification of Matrix Band (Fig. 12.18)

The matrix band can be:

- a. Without retainers – e.g. T-bands, spot welded
With retainers – e.g. Tofflemire matrix retainers
- b. Metallic – e.g. Spot welded, tofflemire matrix bands
Nonmetallic – e.g. Mylar strip.



Fig. 12.18: Commonly used matrix band and retainers; A: T' band; B: Tofflemire; C: Mylar strips

T-Band

The T- band is available in several widths and thicknesses. This type of band is constructed at the time of the restoration. The disadvantage is that some difficulty may be experienced in placing this type of retainer as there is no retainer to hold the band in place.

Construction of T- band (Figs 12.19A to F)

1. Short and long arm are welded into a 'T'
2. The flanges of the short arm of 'T' are bent upwards
3. The long arm of the 'T' is bent into a circle
4. The short arm is folded over the circle formed. The wings should be loose enough for a sliding joint.

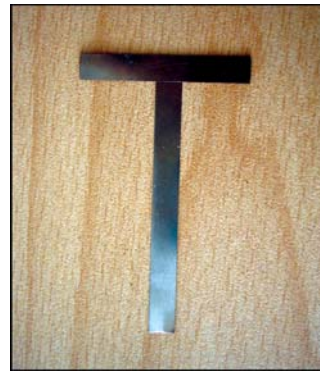


5. The matrix is placed on the tooth with the folded joint on the buccal side of the tooth.
6. The band is held with one finger and the tab is pulled tight around the tooth.
7. The tab is folded back over the joint.
8. The band is removed and flattened with the help of pliers.
9. The band is replaced on the tooth, the wedge placed and restoration completed
10. When the restorative procedure is finished, the band is removed raising the tab over the joint and loosening the band.

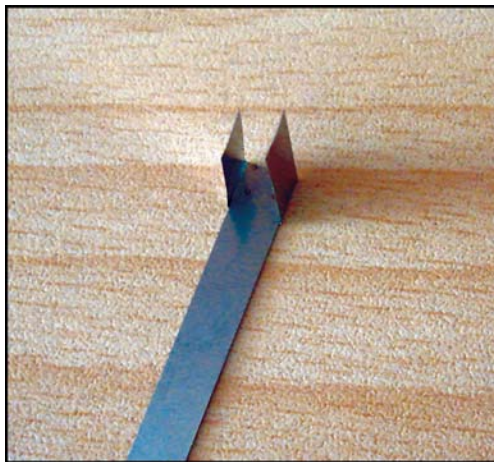
Tofflemire (Fig. 12.20): Its use is restricted to a proximo-occlusal restoration done on a posterior tooth. It is available in straight and contra-angle types.



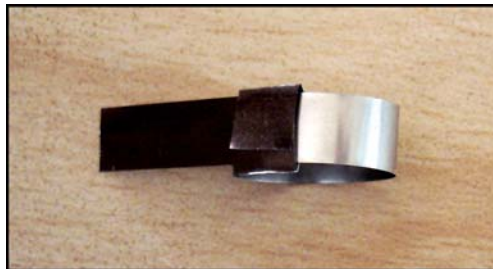
A



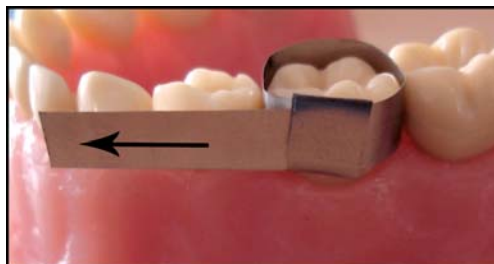
B



C



D



E



F

Figs 12.19 A to F: Steps in the constriction of T-Band

- A. A matrix band is cut into a short and a long arm
- B. Short and long arm are welded into 'T'
- C. The flanges of the short arm of 'T' are bent upwards.
- D. The long arm of the 'T' is bent into a circle. The short arm is folded over the circle
- E. The band is held with one finger and the tab is pulled tight around the tooth. The arrow indicates the direction of pull of the tab.
- F. The tab is folded back over the joint.



Fig. 12.20: Tofflemire retainer in position

Mylar strips (Fig. 12.21): These are nonmetallic matrix band made of plastic used during glass ionomer and composite restorations.



Fig. 12.21: Mylar strip in position

Spot-Welded Matrix Band (Fig. 12.22)

The spot-welded matrix retainer lends itself to the philosophy of back-to-back amalgam restoration. It can be individually custom-made for each tooth.

The steps involved in fabrication are:

1. 5 cm length of band material is cut and the ends of the band are welded together in one spot to form a closed loop.
2. The loop is placed around the tooth and held firmly at the lingual surface with the index finger. With the No. 110 pliers, it is pinched together on the buccal portion until the band is drawn up snugly around the tooth.
3. The band is removed and welded together.
4. The excess band material is cut off 1 mm beyond the welded joint. The cut edges of the band are rounded and bent taking the excess back against the band.

5. The cervical and contact areas are contoured.
6. Holding the band with one finger, the wedge is inserted snugly at the cervical margin. A wedge can be inserted from either the buccal or lingual side to make sure the band is positioned snugly at the gingival margins and walls of the preparation.



Fig. 12.22: Spot welded matrix band

Wedges

Different Types of Wedges

- a. Based on the material used
 - Plastic
 - Wooden
- b. Based on the cross-sectional shape
 - Round
 - Triangular

Triangular wooden wedges are shown in Figure 12.23. Triangular wedges are preferred as they adapt well to the triangular embrasure space causing less trauma to gingiva.



Fig. 12.23: Triangular wooden wedges



Uses of Wedge

1. Adapts the matrix band close to the tooth
2. Protects the gingival papilla
3. Aides in mild tooth separation.

Results of Faulty Wedging

1. A concavity at the cervical portion of the proximal box can result if the rubber dam displaces the wedge or if too large a wedge is used. The purpose of the wedge in the primary dentition is to hold the matrix band at the cervical margins of the proximal box area.
2. An overextension of the restoration material may occur if the wedge is too loosely placed.
3. An open contact is caused by excessive wedging pressure, that to separates the approximating contacts. If the child has primate spacing or space between the teeth, it is not necessary to restore the contact.

ISOLATION TECHNIQUES

The objective of isolation is to provide:

- A dry, clean operating field
- Access and visibility
- Improved properties of dental materials
 - ◆ Protection of the patient and operator
 - ◆ Improved operating efficiency.

Isolation involves 3 conceptual elements

1. *Moisture control* – excludes saliva, sulcular fluid and gingival bleeding from the operating field.
2. *Retraction and access* – provides maximal exposure of the operating site. Involves maintaining mouth opening, depressing or retracting gingival tissue, tongue, lips and cheek.
3. *Harm prevention* – prevent aspiration or swallowing of small instruments, restorative debris or irrigation material and also prevents soft tissue injury.

Different Methods of Isolation

1. Rubber dam
2. High volume evacuator
3. Absorbents

4. Retraction cord
5. Mouth prop
6. Cotton rolls and holders
7. Medicines that reduce saliva – atropine, local anesthesia.

Rubber Dam

It was introduced by S.C. Barnum in 1864. It is used to define the operating field by isolating one or more teeth from the oral environment. The dam eliminates saliva from the operating site and retracts the soft tissues.

Advantages of Rubber Dam

- It provides clean, dry operating field
- It provides clear access and visibility
- It improves properties of dental materials
- Protection of the patient and operator
- Improves operating efficiency
- Prevents aspiration of fluids used
- Prevents accidental ingestion of files/reamers
- Prevents injury to soft tissue such as tongue, cheek, gingiva
- Prevents patient from putting the tongue into the cavity
- Prevents the irrigating fluid coming in contact with oral soft tissues
- Reduced patient conversation
- Patient feels that the tooth is separated from the rest of the body and he will not feel the pain.

Disadvantages of Rubber Dam

- Time consumption
- Patient objection
- Certain conditions may preclude the use of rubber dam like-
 - Incompletely erupted teeth
 - Third molar isolation
 - Extremely malpositioned teeth
 - People suffering from asthma, mouth breathers.

Precautions to be taken while using Rubber Dam

- Patient must not be a mouth breather



- Clamps used must be tightly secured in place and a floss thread must be tied to the clamp, which helps retrieve the clamp if ingested or aspirated.
- The dam should be checked not to cover the nostril
- If patient is allergic to latex, rubber dam napkin should be used
- Lips should be lubricated to provide drying
- The clamp must not impinge on the gingiva nor traumatize the adjacent teeth.

Armamentarium Used for Rubber Dam Application

1. Rubber dam material (Fig. 12.24) – It is made of latex material and is available as:
Size— 5 × 5 inches (Pediatric purpose) or 6 × 6 inches (Adult size)
Thickness— Thin (0.006")
— Medium (0.008")
— Heavy (0.010")
— Extra-heavy (0.012")
— Special heavy (0.014")
Color — green, blue, black, brown.
It has a dull and bright surface. The dull surface should face the occlusal aspect as it reflects less light. Thicker material resists tear and the thinner ones pass through the tight proximal contact easily.



Fig. 12.24: Rubber dam material in pink, green and brown color

2. Retainers:
Wingless retainers (Fig. 12.25A)
Retainers for anterior teeth (Fig. 12.25B)
Winged retainers (Fig. 12.25C)
Retainers are used to anchor the dam to the most posterior tooth to be isolated. Different sizes are available for different teeth.

- Parts of a retainer— It includes bow, jaws, prong (Fig. 12.26). The prongs contact the tooth at 4 regions, two on the buccal and two on the lingual.
3. Rubber dam forceps—used to hold the retainer (Fig. 12.27).
 4. Rubber dam punch— used to punch hole on the dam (Fig. 12.28).
 5. Rubber dam template— guides during placement of the hole (Fig. 12.29)
 6. Rubber dam holder/frame – It can be made of plastic (Fig. 12.30) or metal (Fig. 12.31). It is used to stretch the rubber dam sheet to gain clear access of the operating site.
 7. Rubber dam napkin— used to keep the dam away from the skin especially when the person is allergic to latex. It also absorbs moisture that may appear at the corner of the mouth (Fig. 12.32).



A

B



C

Figs 12.25A to C: Rubber dam clamps or retainers; A: Wingless retainers; B: Retainers for anterior teeth; C: Winged retainers

Placement of Rubber Dam

Steps involved are:

1. Obtaining anesthesia
2. Evaluate the interproximal contact with dental floss

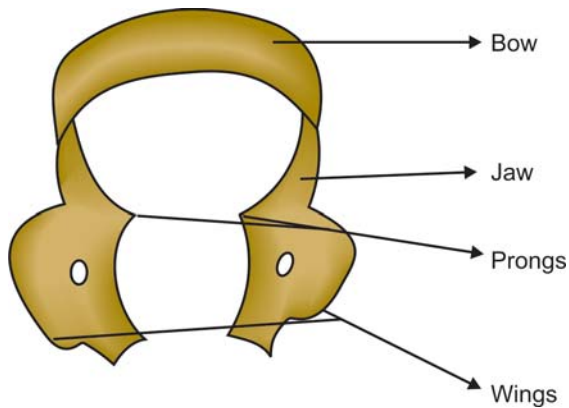


Fig. 12.26: Parts of a retainer

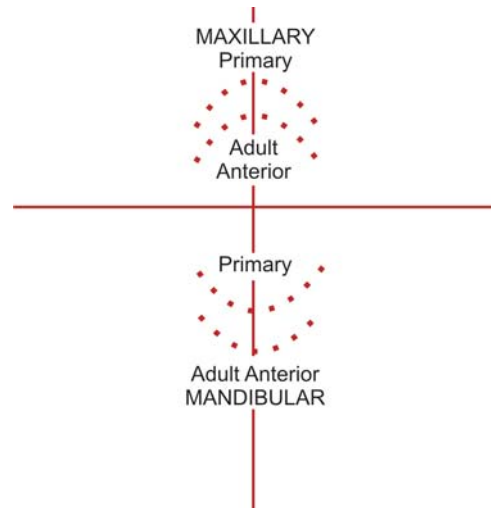


Fig. 12.29: Rubber dam template



Fig. 12.27: Rubber dam clamp forceps



Fig. 12.28: Rubber dam punch



Fig. 12.30: Rubber dam frame — Plastic

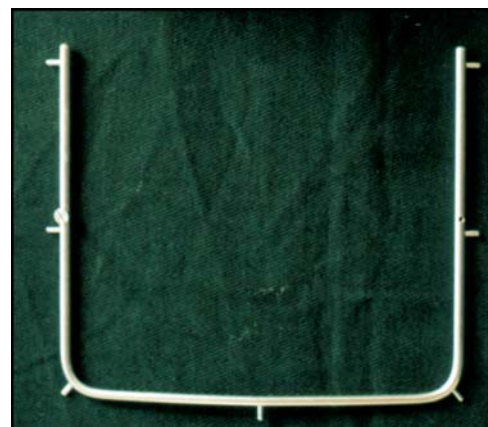


Fig. 12.31: Rubber dam frame — Metal

3. Mark the punch holes— using the template
4. Make punch holes using rubber dam punch
5. Lubricate the area of rubber dam around the punched hole with vaseline
6. Selection of the correct retainer
7. Rubber dam placement (one of the 3 methods)
 - Clamp is placed first on the tooth followed by the sheet
 - The sheet is placed first followed by the clamp
 - Both the clamp and the sheet are placed simultaneously; this is possible when winged clamp is being used.



Fig. 12.32: Rubber dam napkin

Areas where clamps cannot be placed, the sheet can be stabilized with dental floss tied around the neck of the teeth.

8. Placement of napkin and frame.

Rubber dam clamp size preference:
SS White No. 27 is preferred in primary teeth and
Ivory No W14 in the young permanent teeth

Errors in placement of rubber dam:

1. Off centered arch
2. Inappropriate distance between two holes
3. Incorrect arch form of holes
4. Inappropriate sized retainer
5. Retainer pinched tissue
6. Shredded or torn dam.

High Volume Evacuators and Saliva Ejectors

High volume evacuators (HVE) (Fig. 12.33) are used for suctioning water and debris from the mouth. The tip of the evacuator (Fig. 12.34) is placed near the operating area.

The saliva ejector (Fig. 12.35) removes saliva that collects on the floor of the mouth (Fig. 12.36). It is used in conjunction with sponges, cotton rolls and rubber dam. Saliva ejectors remove water slowly and are less efficient to pick debris (Fig. 12.37). It should be placed in an area least likely to interfere with the operator's movements usually in the floor of the mouth. The tip of the ejector must be smooth and made from a nonirritating material. Disposable and inexpensive plastic ejectors may be shaped by bending with the fingers and used.

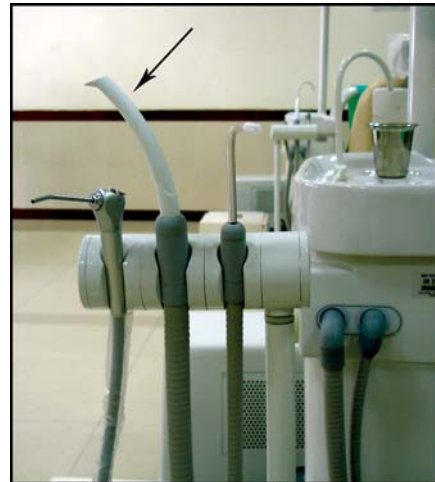


Fig. 12.33: High vacuum evacuators



Fig. 12.34: The tip of HVE is wide enabling suctioning of debris



Fig. 12.35: Saliva ejector



Fig. 12.36: The saliva ejector is placed in the floor of the mouth

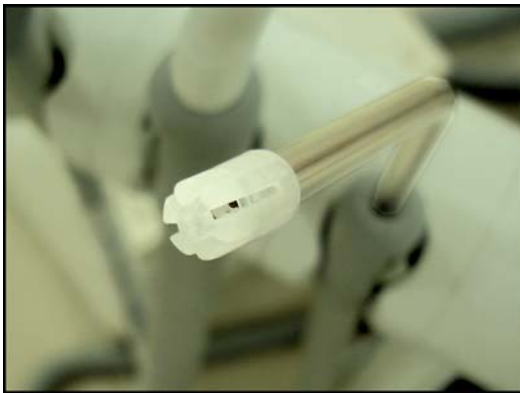
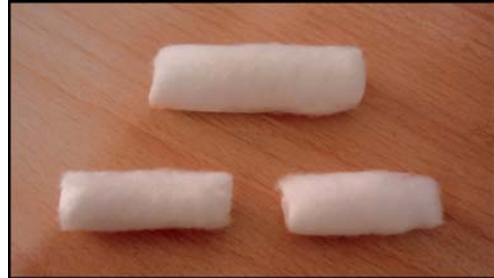


Fig. 12.37: The tip of saliva ejector is very narrow enabling suction of only liquids

the posterior part of the mouth acts as a shield. It helps to retrieve any instruments (Files or broaches) or restorations that would have accidentally slipped, which otherwise would have been aspirated or swallowed.



A



B

Figs 12.38A and B: A. Cotton rolls used for isolation. B. Cotton rolls position in the mouth

Absorbents and Throat Shields

Absorbents such as cotton rolls (Fig. 12.38) and cellulose wafers are used for short periods of isolation and topical fluoride applications. They are alternatives when rubber dam application is impractical or impossible. Cotton rolls have to be positioned one each on the buccal and lingual vestibule adjacent to the working tooth and one in the upper buccal vestibule on the same side corresponding to the major salivary glands while operating in the lower quadrants. While operating on the upper quadrants, one cotton roll is positioned in the buccal vestibule adjacent to the working tooth.

Throat shields (Fig. 12.39) are indicated when small instruments are being used without rubber dam. A gauze piece (2×2 inch) that is spread over the tongue and



Fig. 12.39: Throat shield. It is especially useful when operating on the upper posterior tooth where the access is limited due to reduced mouth opening in children. While operating on the lower teeth, the tooth to be treated should be exposed and the shield can be placed on the tongue extending posterior to the operating tooth



SILVER AMALGAM RESTORATIVE MATERIAL

Silver amalgam restorative material is obtained by the trituration of amalgam alloy with mercury.

Classification of Amalgam Alloy

1. According to the shape
 - Lathe cut (Irregularly shaped)
 - Spherical (Spherical in shape)
 - Mixed (Contain mixture of lathe cut and spherical)
2. According to the size
 - Fine cut (Partical size is 36μ)
 - Micro cut (Partical size is 26μ)
3. According to the composition
 - Low copper alloy (Contains $<6\%$)
 - High copper alloy (Contains $>6\%$ $< 30\%$)
 - Admixed alloy (mixture of low and high copper alloy)
4. Zinc containing/Non-zinc containing
 - Some alloys contain zinc. It acts as deoxidizer or scavenger (0-2%)
5. According to the method of dispensing
 - As powder and liquid form
 - As a capsule (Fig. 12.40)
 - As pellets or pills of alloy powder
 - As preamalgamated powder (3% of the Hg is mixed with the alloy powder and this facilitates faster reaction).



Fig. 12.40: Amalgam alloy and mercury in capsule form

Properties of Amalgam

1. Increased mercury – leads to increased expansion, creep and corrosion
2. Compressive strength – Admixed is 430 Mpa after 7 days
3. Tensile strength – Admixed is 50 Mpa after 24 hours
4. Surface hardness – 110KHN
5. Working time – 3-8 minutes
6. Setting time – 5-10 minutes
7. Increased expansion is due to: increased mercury, short trituration, low condensation pressure and water contamination
8. Creep is associated with: increased or decreased trituration, time lag between trituration and condensation, increased mercury, less condensation force.

Criteria for Selection of Amalgam Alloy

1. Small particles are selected: Better strength, good surface finish, good marginal adaption, poor corrosion resistance
2. Spherical is selected: Better strength, easy to carve, good finish, good marginal adaptation, good corrosion resistance and easy condensation. (Lathe cut resists condensation, may result in a porous, poor corrosion resistance restoration with rough surface and poor marginal adaptation)
3. High copper is preferred: Better strength, less creep, good corrosion resistance due to absence of α -2 phase.

Drawbacks of Silver Amalgam

1. Good conduction of heat: Requires good insulation
2. Poor marginal adaptation: So varnish is applied
3. Poor esthetics
4. Poor modulus of elasticity, proportional limit and tensile strength
5. Electrolytic corrosion
6. Poor adhesion to tooth structure
7. Ditched amalgam.

Condensation and Carving of Silver Amalgam

1. The amalgam alloy and mercury is dispensed and mixed as per the manufacturer's instructions (Fig. 12.41).



2. The material is loaded into the amalgam carrier (Fig. 12.42). Proximal box is first filled in a class II cavity. In other cavities it is started from one side slowly moving and filling the entire cavity.
3. The material is firmly condensed into the cavity. Amalgam is condensed using condensers. The initial condenser should be small (Fig. 12.43A) enough to condense the material into the line angles. Each condensing stroke should overlap the previous condensing stroke to ensure that the entire mass is well condensed. The cavity is overfilled and condensed with a large condenser (Fig. 12.43B). Parallelogram condenser (Fig. 12.43C) is used to condense narrow occlusal cavities.
4. This is followed by precurve burnishing of the amalgam. It is a form of condensation done with a large ball burnisher (Fig. 12.44A) using heavy strokes mesiodistally and faciolingually. This helps to remove all the excess amalgam and blends the restorative material with the cavity margins.
5. Initial gross carving of the restoration is done followed by fine carving of cuspal inclines, triangular fossa and the grooves. Hollenback, wards or diamond amalgam carvers are used for the purpose of carving amalgam (Fig. 12.45).
6. Wedges and the matrix band can be removed after initial carving.
7. Postcarve burnishing is done using ball burnisher (Fig. 12.44B): It involves the light rubbing of the carved surface to improve smoothness and produce a satin (not a shiny) appearance.
8. Finishing and polishing is done after 24 hours of insertion.



Fig. 12.41: Silver amalgam ready to use



Fig. 12.42: Silver amalgam loaded into the amalgam carrier



A

B

C

Figs 12.43A to C: Amalgam condensers; A: Small round condenser; B: Large round condenser; C: Parallelogram condenser



A

B

Figs 12.44A and B: Ball burnisher; A: Large ball burnisher; B: Small ball burnisher



Fig. 12.45: Amalgam carvers; A: Hollenback carver; B: Wards carver; C: Diamond carver

Armamentarium used for Finishing and Polishing of Amalgam:

1. Pointed, white, fused alumina stone or a green carborundum stone is used to correct minor discrepancy
2. Green stone – is more abrasive than white stone and thus is used for correction of gross discrepancies
3. Finishing burs
4. Coarse rubber abrasive point at low speed
5. Medium and fine grit abrasive points in low speed
6. Final polishing – rubber cup with pumice and chalk

Mercury Hygiene

Precautions that should be taken regarding the mercury exposure in dental office to protect the office staff and the patients are:

- When removing an old amalgam restoration, rubber dam should be in place and high volume evacuation should be used. Glasses and disposable face masks should be worn.
- Amalgam capsules should be preferred to the conventional dispensing.
- Closed amalgamators should be used.
- Free mercury and amalgam scraps should be stored in an unbreakable, tightly closed container away from any source of heat preferably in water.

- Since mercury vaporizes at room temperatures, operatories should be well ventilated to minimize the mercury level in the air.

GLASS IONOMER (POLYALKENOATE CEMENT) CEMENT

The invention of the glass ionomer cement in 1969 (reported by Wilson and Kent in 1971) resulted directly from basic studies on dental silicate cements and studies where the phosphoric acid in dental silicate cements was replaced by organic chelating acids.

Glass = formulation of glass powder

Ionomer = ionomeric acid with carboxyl group

Classification of Glass Ionomer Cement

- Type I – Luting cement
- Type II – Restorative cement
- Type II 1 – Esthetic restorative cement
- Type II 2 – Reinforced restorative cement
- Type III – Lining or base cement

Development of Glass Ionomer Restorative Material

During early studies in 1965 and 1966 AD, Wilson examined cements prepared by mixing dental silicate glass powder with aqueous solutions of various organic acids including polyacrylic acids. The first glass ionomer cements lacked workability and hardened slowly. Eventually Kent et al (1973, 1979) found a glass that was high in fluoride that gave usable cement, ASPA I which still had some drawbacks.

The key discovery was made in 1972 by Wilson and Crisp, who found that tartaric acid modified the cement forming reactions, thus improving manipulation, extending working time and greatly sharpening the setting rate. This refinement of ASPA I was termed ASPA II and constituted the first practical glass ionomer cement. Over the years research workers have further improved glass ionomer cements in terms of setting rate, translucency and strength.

Composition of Glass Ionomer Cement

Glass ionomer cement is a product of an acid-base reaction. The basic component is a calcium aluminosilicate glass containing fluoride. The acid is a



polyelectrolyte, which is a homopolymer or copolymer of unsaturated carboxylic acids known scientifically as alkenoic acids. Most commonly used is polyacrylic acid. Powder

- Calcium fluoroaluminosilicate glass
- Lanthanum, strontium, barium or zinc oxide

Liquid

- Polyacrylic acid (50%)
- Itaconic acid (increases the reactivity and reduces the viscosity and tendency for gelation)
- Maleic acid, or tricarboxylic acid
- Tartaric acid – improves handling characteristics, increases viscosity and working time and reduces setting time.

The three essential constituents of dental ionomer glasses are silica (SiO_2), alumina (Al_2O_3), and calcium fluoride or fluorite (CaF_2).

The visual appearance of the glass depends on its chemical composition – glasses high in silica (>40%) are transparent, high in Al_2O_3 or CaF_2 are opaque

Water Settable GIC or Anhydrous GIC

To extend the working time, the powder contains freeze dried acid powder. Water is used to mix the material.

Glasses are prepared by fusing the components between 1100°C to 1500°C and then poured onto a metal plate. The glass is then ground to a fine powder depending whether it is a type I ($30\text{-}50\mu$), II ($15\text{-}20\mu$) or III ($< 15\mu$).

Role of Fluoride in Glass Ionomer Cement is as Follows:

- It lowers the temperature of fusion
- Improves the working characteristics of the cement paste
- It increases markedly the strength of the set cement
- In moderate amount it enhances translucency
- Contributes to therapeutic value of the cement by releasing fluoride over a prolonged period.

Setting Reaction of Glass Ionomer Cement

When the glass ionomer cement powder and liquid are brought together to form a paste, the glass powder which is basic reacts with liquid that is acid, to form a salt hydrogel which is the binding matrix. Here water in the reaction medium forms a part of the hydrogel.

Different Stages in the Setting Reaction

- Initially the surface of the glass is attacked resulting in decomposition of the glass and release of Al and Ca ions
- These Al and Ca ions then migrate into the aqueous phase of the cement.
- As the reactions proceed the concentration of ions and the viscosity of the paste increases.
- Initially calcium ions forms part of the cross linkage with polyacrylic acid chains to form solid mass.
- Later within next 24 hours new phase is formed with aluminium ions becoming bound to cement matrix– leading to more rigid set cement.
- Gelation of the polyacids occurs by the metal ions leading to set cement.
- Calcium polyacrylate is responsible for the initial set and aluminium polyacrylate for the final hardening of the matrix.
- Sodium and fluoride do not participate in the cross linking of the cement. Some sodium ions may replace H^+ of carboxylic group, but rest combine with fluoride to form NaF which is uniformly dispersed within the cement.
- Unreacted glass particles are coated by silica gel (that forms during removal of the cations from the surface of the particles).
- Final set cement consists of agglomerated unreacted powder particles surrounded by a silica gel in an amorphous matrix of hydrated calcium and aluminium polysalts.

Role of Moisture Contamination and Dehydration

During the setting process the cement should be protected from two extremes – desiccation and aqueous environment. This can be achieved in an atmosphere of 80% relative humidity. The cement should be protected by varnish or petroleum jelly.



It is important to remember that after initial set but before the cement is fully hardened, a proportion of cement containing aluminium, calcium, fluoride and polyacrylate ions are in soluble form and so can be dissolved out of the cement by aqueous fluid leading to permanently weakened matrix.

If at this stage water is released out due to excessive drying, restoration will lose its aesthetic appeal, shrink and will become brittle. It may take 1 hour until the cement remains vulnerable to moisture. Hardening continues for 24 hours. Slow maturation continues over the period of months and becomes more rigid and gathers strength.

Factors Affecting Setting Characteristic of Glass Ionomer Cement

- *Role of fluorides* – fluoride forms metal complexes that retards the binding of cations to anionic sites on the polyelectrolytic chain and thereby delaying gelation and prolonging working time. It also delays pH dependent gelation.
- *Role of tartaric acid* – it improves manipulation of the cement and increases the working time, it increases the viscosity and increase the strength of the set cement.

Factors Affecting Rate of Setting of Glass Ionomer Cement

1. Glass composition, especially the $\text{Al}_2\text{O}_3/\text{SiO}_2$ ratio and fluoride content. Increased ratio – faster is the set, shorter is the working time. Fluoride prolongs the working time.
2. Particle size – finer particle size- faster is the set and shorter is the working time.
3. Addition of tartaric acid sharpens the set without shortening the working time.
4. Relative proportion of constituents in the cement mix, i.e. glass/polyacid/tartaric acid/water. Greater proportion of glass and lower proportion of water, faster is the setting time and shorter is the working time.
5. Temperature of mixing – in higher temperature the faster is the set, shorter is the working time.

Properties of Glass Ionomer Cement

Physical Properties

- Sets rapidly in the mouth.
- Initial compressive strength is low (24 hours)–150-200 Mpa but increases with time. After one year it can reach to 400 Mpa.
- Tensile strength (24 hours) – 6.6 Mpa
- Hardness – 70 KHN
- Solubility – 0.7%
- Bioactive and possesses chemical bonding with the tooth.
- Coefficient of thermal expansion is close to that of the tooth causing less microleakage around the restoration.

Esthetics

- Translucent material.
- Color is much more stable. Resistance to stain is dependent on a good surface finish.

Adhesion

- Permanently adheres to the untreated enamel and dentin chemically.
- Principle barrier to adhesion is water.
- Mechanism of adhesion – chelation of carboxyl group of the polyacids with the calcium ions in the apatite of enamel and dentin forming strong ionic bonds. This ionic bonds are later replaced by hydrogen bonds which increases the strength as the material sets. Surface conditioning also improves adhesion.

Biocompatibility

- Excellent marginal seal and fluoride release –reducing the risk of developing secondary caries
- Continuous fluoride release occurs around the restoration –tooth interface (3 mm) for a period of 18 months.
- The acid groups are attached to the polymer molecule which have limited diffusibility, hence the pulp effects are limited to areas immediately adjacent to the material. When fluid filled dentinal tubules are in



direct contact with the unset material, 2 problems occur:

1. High ionic concentration in the material cause dentinal fluid to rapidly diffuse outward into the cement producing a change in pulpal pressure, creating pain and sensitivity.
 2. Hydrogen ions may move into the tubules towards the pulp and cause chemical irritation. When the dentin thickness is less, there is less fluid to buffer the acid.
- Inflammatory response of pulpal tissue toward GIC is more than zinc oxide eugenol but less than zinc phosphate cement and resolves in 30 days without reparative dentin formation. It is said that a lining of calcium hydroxide or zinc oxide eugenol is required when less than 0.5- 1mm of sound dentin remains over the pulp.

Initially citric acid was used as conditioner followed by 25% polyacrylic acid, tannic acid, ferric chloride, sodium or EDTA. The latest is the use of 10% polyacrylic acid for 15-20 seconds followed by rinsing for 20 seconds.

Steps Involved in Clinical Placement of Glass Ionomer Cement

1. Shade selection.
2. Isolation of the tooth, rubber dam is the material of choice.
3. Cavity preparation, the objective is to remove all caries and unsupported enamel. Minimal extension is the key word.
4. If the dentin thickness is 0.5-1 mm, lining of calcium hydroxide should be placed.
5. Surface preparation – The surface smear layer is removed by pumice wash. The tooth surface is conditioned with 10% polyacrylic acid application for 10-15 seconds followed by 30 seconds water rinse.
6. Cement is mixed according to the manufacturers instructions (Figs 12.46 A and B). It should be mixed rapidly to gain working time and should not be more than 45-60 seconds. The tooth should be isolated all through.

7. Place a matrix wherever possible and fill the cavity with the GIC.
8. Remove the matrix and immediately protect it with waterproof material like varnish or vaseline.
9. Trim the excess with scalpel. Rotary cutting instruments should not be used.
10. After the removal of the excess material a layer of protective material is reapplied.
11. Finishing and polishing is done after 24 hours.
12. Reapply the protective material after finishing and polishing.



A



B

Figs 12.46A and B: A. Glass Ionomer mix should have a glossy surface (Denoting the availability of free carboxyl group that is required for setting reaction) during placement into the cavity; B. Set Glass Ionomer cement losing its sheen

Critical Procedures for Glass Ionomer Restoration

1. Surface conditioning to remove the smear layer
2. P:L ratio must be maintained
3. Mixing time – not more than 45-60 seconds and surface should be glossy, due to the polyacid that has not participated in the reaction which helps in bonding.



4. Placement of material – with plastic instrument or injected. Mixed material should be used within 5 minutes and surface should be protected with varnish.
5. Surface finishing – delayed for 24 hours.

Modifications of Glass Ionomer Cement

It is done to improve the strength, fracture toughness and resistant to wear.

- A. Silver alloy admix – mixing spherical silver amalgam alloy powder with Type II glass ionomer
- B. Cermet – fusing glass powder to silver particles
- C. Resin modified GIC – to overcome moisture sensitivity and low early strength. Also called as light cured, dual cure (L.C and acid-base reaction), tricure (dual cure and chemical cure), resin ionomer, compomers or hybrid ionomers.

Resin Modified Glass Ionomer Cement

Composition

- Powder - Ion leachable glass
- Initiator for light or chemical curing or both
- Liquid - Water
- Polyacrylic acid/polyacrylic acid with carboxylic group modified with methacrylate and hydroxyethyl methacrylate monomers.

Setting Reaction

Initial reaction is polymerization of methacrylate group, followed by acid-base reaction.

Physical properties

- The difference is due to presence of polymerizable resins and less amount of water and carboxylic acid in liquid.
- Tensile strength is higher than that of conventional GIC
- Greater amount of plastic deformation
- Bonding similar to conventional glass ionomer cement
- Higher bond strength compared to composite resin
- Greater degree of shrinkage – due to polymerization, lower water and carboxylic acid content.
- Reduced water sensitivity
- Transient temperature increase during polymerization

Advantages

- Extended working time
- Improved physical properties
- More resistant to dehydration and cracking.

COMPOSITE RESIN RESTORATIVE MATERIAL

“Composite materials” are formed from two constituents that are insoluble in each other”. R L Bowen developed modern dental composite restorative materials in late 1950s and was introduced to dentistry in the early 1960s. He conducted experiments on reinforcing epoxy resins with filler particles.

Since epoxy resins have some disadvantages or shortcomings like slow cure and tendency to discolor, he combined the advantages of epoxy resin and acrylic resin leading to the development of BIS-GMA molecule. It is an aromatic ester of dimethacrylate, with epoxy resin as the backbone and acrylic as functional reactive group.

Composite restorative material is ideal for anterior tooth restoration due to its excellent color matching (Fig.12.47).



A



B

Figs 12.47A and B: Composite restoration of fractured central incisors; A: Fractured teeth; B: Restored with composite



Composition

1. **Resin matrix:** BIS-GMA is the most commonly used resin followed by urethane dimethacrylate. Diluent monomers like methyl methacrylate monomer or dimethacrylate monomers, such as TEGDMA (triethylene glycol dimethacrylate) are used to attain higher fillers levels and to produce pastes of clinically usable consistencies.

A blend of BISGMA + TEGDMA in 75: 25 wt% has a viscosity of 4300 centipoise, whereas that of 50: 50 blends is 200 centipoise.

TEGDMA allows extensive cross linking to occur between chains resulting in a matrix that is more resistant to solvents, but also increase the polymerization shrinkage.

2. **Filler particle:**

- Improves the properties of the matrix material
- Reduces polymerization shrinkage
- Reduces water sorption and coefficient of thermal expansion
- Improves tensile strength, compressive strength and modulus of elasticity and abrasion resistance.

Materials used as fillers are-

- Colloidal silica
- Quartz
- Barium
- Strontium
- Zirconium

Quartz has been used extensively as filler particularly in conventional composites. Advantage is that it is chemically inert but it is so very hard that it is difficult to polish and may abrade opposing teeth or restoration. Other materials are not as stable as quartz and may leach out into aqueous medium.

Translucency of the filler must be similar to that of tooth structure and its index of refraction must closely match that of resin. For BISGMA + TEGDMA combination refractive index is about 1.5. Most of the glass or quartz that are used as fillers have R. I. of 1.5.

Hardness

- Filler-600-1100 DPN
- Matrix-80-130 DPN

Advantages of filled resin over unfilled resin

- Reduced polymerization shrinkage
- Less water sorption and coefficient of thermal expansion
- Improved mechanical properties- compressive strength, tensile strength, and modulus of elasticity

3. **Coupling agent:** It provides a bond between the resin matrix and fillers, thus improving the physical and mechanical properties and providing hydrolytic stability by preventing water from penetrating along the resin – filler interface.

E.g. Organosilanes are commonly used (e.g. 3-methoxy-propyl-trimethoxy silane). Others are titanates and zirconates.

4. **Inhibitors:**

- Hydroquinone, butylated hydroxytoluene (<0.01%)
- Minimizes or prevents spontaneous polymerization. It reacts with free radicals that are formed.

5. **UV Absorbers:** To improve color stability, E.g. 2 hydroxy-4 methoxy benzophenols.

6. **Activators:**

For self cure – tertiary amine
Light cure – light

7. **Initiators:**

Self cure – benzoyl peroxide,
Light cure – α – diketones like camphorquinone,
UV Light — benzoin methyl ether,

8. **Pigments**

Classification of Composite Resins

Classification Based on Filler Particle Size

- Megafiller - $>100\mu$ (megafil)
- Macrofiller - $10-100\mu$ (macrofil)
- Midifiller - $1-10\mu$ (midifil)
- Minifiller - $0.1-1\mu$ (minifil)
- Microfiller - $0.01-0.1\mu$ (microfil)
- Nanofiller - $0.005-0.01\mu$ (nanofil 10^{-9})
- Picofiller - $< 0.005 \mu$



Heavily filled material contains inorganic filler about 75% wt. or more

Lightly filled material contains inorganic filler about 66% wt. or less

Based on the Mean Particle Size of the Major Filler

1. Conventional - 8-12 μ m
2. Small particle - 1- 5 μ m
3. Microfilled - 0.04-0.4 μ m
4. Hybrid - 0.1-1.0 μ

Based on the Method of Polymerization

1. Self cured
2. Light cured

Properties

- A. Linear coefficient of thermal expansion is twice as much the value of amalgam and 3-4 times greater than that for tooth structures.
- B. Most composites can be practically cured only to levels of 55-65% conversion of monomer sites, usually due to inadequate curing energy from visible light cure unit and is improved by post-curing.
- C. Water absorption swells the polymer portion and promotes diffusion and desorption of any unbound monomer. Water plasticizes the composite and chemically degrades the matrix into the monomer. Increased filler content, lower is the water absorption.
- D. Microfill composites are the least wear resistant.
- E. Composites with high matrix content and self cured have more tendency to undergo yellowing. Addition of U.V light absorbers and antioxidants reduce this chance of yellowing.
- F. Beveling tends to blend any color difference associated with margin and provides more surface area for bonding.
- G. Good marginal integrity- Butt joints margin wear slowly but create a meniscus appearance against enamel. Beveling produces thinner ledges of material that are prone to fracture.
- H. Biocompatible, but unpolymerized materials are potentially cytotoxic, they are very poorly soluble

in water and are polymerized into a bound state before dissolution or diffusion.

- I. Compared to unfilled resins, filled resins are more stronger, increased modulus of elasticity (increased modulus of elasticity – less is the flexibility and vice versa), good abrasion resistance and lower coefficient of thermal expansion.

Light Cured Composites

These materials are dispensed in a single paste form, thus requiring no mixing and so eliminating human variable.

- Working time is as chosen by the dentist. Cure is fast, deep and reliable compared to UV light cured composites.
- Increased color stability.
- Incremental technique is used for restoring the tooth with composite, as the depth of penetration is less, but this technique compensates for polymerization shrinkage.
- Wave length of light used is 400-500 nm (peak intensity is 470 nm).
- Optimal polymerization is important for color stability, physical and biological properties.
- High intensity light should be used.
- Exposure time is 40-60 seconds.
- Resin thickness to be cured should not be more than 2-2.5 mm.
- Dark shades require longer exposure time, as they tend to absorb the light.
- Composites straight from the refrigerator takes longer to cure than those at room temperature.
- Light used cause retinal damage, so direct visualization of the light is avoided and protective shield should be used.
- Dual cured composites combine self curing and light curing.
- Unreacted monomer is capable of diffusing out of the polymer either into dentin or onto external tooth surfaces.
- Intensity of the light striking the composite is inversely proportional to the distance from the tip of the light source to the composite surface. Ideally tip should be within 2 mm and perpendicular to the surface.



- Output energy of light unit, should be 300 mw/ cm² and is monitored with a radiometer.
- Degree of conversion of monomer to polymer is related to intensity and duration of exposure of light, i.e. about 20-60 seconds.
- The material can abrade steel, so use of steel instruments should be avoided during manipulation.
- The material should not be spatulated, as it may incorporate air.
- Pretreatment of primary enamel surface with a coupling agent (butyl acrylate-acrylic acid copolymer mixed with glycidal methacrylate in an alcohol solution) after etching significantly increases the resin-enamel bond strength.

- Etching time of 15 seconds provide as strong a bond
- Increased fluoride content of tooth is associated with longer etching time.

Acid Etchant – Technique

The technique of acid etching consists of applying 30-50 % H₃PO₄ to enamel for 30-60 seconds, followed by rinsing and drying. This process leads to the formation of numerous microscopic pores that acts as undercuts. This aids in resin-enamel micro-mechanical bond. The tooth to be etched is isolated from fluids by rubber dam, cotton roll or retraction cord. Liquid and gel etchants are available in the concentration of 37% or 50% H₃PO₄.

After acid etching, care should be taken that the area is kept free of saliva or sulcular weepage. If there is contamination the surface is re-etched for 10 seconds. Etched enamel has a high surface energy, and allows resin to wet readily the surface and penetrate into microscopic porosity. Once the resin penetrates into the microporosity, it can be polymerized to form a mechanical bond to the enamel. These resin tags may penetrate 10-20μm into enamel, but the length is dependent on the etching time.

Etching Primary Teeth

- Reduced bond strength of resin to etched primary enamel
- Few tags are formed and do not produce a good retentive surface
- The presence of prismless layer on outer enamel surface produces an uniform surface when etched
- Reduced resin retention on primary teeth may be due to the larger amount of exogeneous organic material in deciduous enamel

Liquid Etchant

They are used to etch large surface areas of enamel. Applicators include small cotton pellets, foam, sponge and brushes.

Acid is applied gently to the enamel surface keeping the extension to a maximum to 0.5 mm. from the cavity margin past the extent of the restoration. Application is repeated every 10-15 seconds to keep the area moist for 30 seconds, care should be taken not to flood the area with acid or to rub the enamel. The area is rinsed with water for 10-15 seconds. The area is then dried with clean dry air. The enamel must appear as having a ground glass or lightly frosted appearance.

Gel Etchant

It is made by adding colloidal silica to acid. Thixotropic gels are most preferred, as controlled application is possible. Applied with a brush, paper point, instrument or syringe. Procedure is the similar to liquid etchant, but a long rinse is required to wash off the gel.

Three Basic Types of Surface Characteristics in Etched Enamel (Silverstone, 1975)

Type 1 Pattern: Most common pattern seen. Prism core material is preferentially removed, leaving the prism peripheries relatively intact.

Type 2 Pattern: Peripheral region of prism was removed leaving prism cores relatively unaffected.

Type 3 Pattern: There was a more random pattern, areas of which corresponds to type 1 and 2 pattern, together with regions in which the pattern of etching could not be related to prism morphology.

All 3 patterns were found in single samples of etched enamel, suggesting that there is no specific etching pattern produced in human dental enamel by the action of acid.



Type 4 Pattern: (Not described by Silverstone) Surface loss occurs without exposing the prism, usually seen in the cervical areas where prism do not extend upto the surface.

Bonding Agent

These are unfilled resins that are applied on the etched tooth surface before the placement of the composite resin material. Composite material since it is more viscous does not penetrate the micropores created due to acid etching. The bonding agent is less viscous and flows into the micropores and bonds with the composite resin.

Smear layer: is $0.5\text{-}5\mu\text{m}$. and consists of blood, saliva, bacteria, enamel and dentin particles. Some believe that smear layer acts as an effective, natural cavity liner that seals the dentinal tubules and reduces permeability making the smear layer a clinical asset, while others argue that smear layer interferes with adhesion of restorative material, serves as a focus for bacteria and its toxins.

Individual Components of Bonding Agents

Dentin conditioner

Objective: To create a surface that is capable of micromechanical or chemical bonding with bonding agent.

Methods of conditioning

1. Chemical – acids, chelators
2. Thermal – lasers
3. Mechanical – abrasives such as aluminium oxide, creates a smear layer that might be used to enhance the bond strength of smear mediated dentin bonding agents.

Dentin primers: It forms thickness of $0.5\text{-}1\mu$. Increases the wettability of bonding agent on the conditioned dentin.

Bonding agent: It forms resin tags into the tubules and more important is the penetration of bonding agents into intertubular dentin, to form a hybrid layer.

Resin reinforced zone or Hybrid layer (Nakabayashi et al 1982): The primer wets and penetrates the collagen network/meshwork, raising it almost to its original level. It also increases the surface energy of dentinal surface. Unfilled resin then penetrates the primed dentin, copolymerizing with the primer to form an intermingled layer of resin and collagen.

Critical Factors Affecting Adhesion

The surface of enamel over which the unfilled resin must flow should have surface energy higher than the resin. Instrumented surface release polar substances that form low energy surface layer.

- A. Salivary and blood contamination - contamination after placement of a bonding agent and before curing is critical. If the bonding agent that utilizes the smear layer for bonding is used and is washed, the smear layer gets washed off. So in such cases following washing, the dentin is roughened, this allows the formation of a smear layer once again over which the bonding agent is placed. If the surface is contaminated, it is reconditioned with 37% phosphoric acid for 10 seconds followed by reapplication of bonding agent.
- B. Oil contamination
- C. Surface roughness of the tooth surface- mechanical retention may increase slightly.
- D. Mechanical undercuts – they hold the restorative materials from bodily dislodgment from the preparation and may also resist microscopic movement of the restoration caused by thermal or polymerization influences.
- E. Fluoride content of the tooth – etching time is doubled in tooth with increased fluoride.
- F. Presence of plaque/ calculus/ stains/ debris- they prevent etching and the surface becomes shiny when etched.
- G. Presence of bases, liners or varnishes should not be applied.
- H. Tooth dehydration – overdrying of dentin before the placement of the bonding agent is as damaging as placing bonding agent in a wet field.



- I. Constituents of temporary cement – fresh eugenol could be a negative factor for resin polymerization. Eugenol is completely absorbed in ZnOE of >7 days old and rendered inert.
- J. Intimate contact - > 0.0007 between the tooth structure and the adhesive is ideal.
- K. Clean tooth surface
- L. Wettability of the adhesive – surface tension of the liquid must be less than the surface energy of the enamel and dentin. Freshly etched enamel has twice the surface energy than unetched surface.
- M. Adhesion also depends on the amount of polymerization shrinkage of the resin.

Classification of Bonding Agents

Lot of development has occurred with respect to bonding agents. Based on its development, they can be grouped as Generation I, II, III, IV and V.

First Generation: They were little more than enamel bonding agents, the resulting bond strength to dentin was 2.0 mpa and required an adequate enamel surface to give sufficient bond strength. This generation of bonding agents was primarily intended for small CI III and CI V. It still used amalgam like cavity preparation for retention. Post-operative sensitivity was common with posterior restoration.

For example, Glycerophosphoric acid dimethacrylate, cyanoacrylate were used with HCl etching.

Second Generation: This generation bonding agents used dentinal smear layer for bonding. Bond strength obtained were in the range of 4-6 mpa. Mechanical retention form was still necessary and post-operative pain reduction was not significant. With low bond strength, there was risk of marginal leakage. 12-month retention rate was 70%.

For example, Phosphate ester systems and poly-urathanes/BISGMA/HEMA (forms covalent bonds with hydroxyl group in both organic and inorganic phases of dentin).

Bonding mechanism involves a surface wetting mechanism as well as ionic interaction between the phosphate group and calcium. Since they bond to smear layer, bond strength is limited by the cohesive strength

of the smear layer or by adhesion of the smear layer to underlying dentin.

Third Generation: Two component primer/adhesive system were introduced in 90's. There was a significant increase in the bond strength upto 10mpa. There was also noticeable reduction in post-operative sensitivity and diminished the need for retention form. These were the first to bond to metals and ceramics. The main problem was longevity. Retention decreased after 3 years. This requires either modifying or completely removing the smear layer. All though these agents completely do not eliminate marginal leakage, they are better than the previous generation. 98% retention rate was observed at the end of 6 months.

For example, Tenure system – smear layer is replaced by (nitric acid/phosphoric acid) aluminum oxalate crystal.

Gluma bond –HEMA and glutaraldehyde bond to organic phase of dentin

Scotch bond 2 — (10% maleic acid) BISGMA, HEMA and photo initiator

Fourth Generation: They were characterized by the formation of zone of hybridization. Bond strength increased upto 18 mpa. The concept of total etch and moist dentinal bonding for acetone containing primer is the hall mark of this generation. Post-operative sensitivity was low. It is characterized by their numerous components, increasing the complexity of the clinical procedure.

For example, Mirage – nitric acid, NPG-GMA

Prisma 2 – HEMA, PENTA

XR bond– ethylalcohol, DMA, phosphate ester, camphoquinone

All bond –(etched with 10% phosphoric acid) succinic acid, HEMA

Fifth Generation: It is one component one bottle bonding system. Primming and bonding sequence involves a single liquid and bonding sequence involves a single liquid in a single bottle. It is simple and faster work. Bond strength of 15-20 mpa is obtained. Rare postoperative pain was observed. Some fifth generation materials can be used without etching and still can produce excellent bonding value. Some systems have



incorporated fluoride release as well as elastomeric component to improve marginal integrity. It is simple to use resulting in significantly reduced chair time and totally eliminating mixing.

Clinical performance – less satisfactory in sclerotic cervical lesion. Flexure forces can result in fatigue failure of the bonding interface between dentin and resin.

For example, Prime and Bond 2.1, Syntac single component, Bond 1, One-step and Tenure

Sixth Generation Bonding Agent: There are two types of 6th-generation bonding agents. Type I bonding agents have self-etching primers and adhesive components that are applied separately to the tooth, whereas Type II self-etching agents are first mixed and then applied.

Seventh Generation Self etching primers and bonding agents with organic fillers: The 7th-generation bonding agents are self-etching adhesives that require no mixing. These self etching bonding agents dissolve the smear layer of tooth structure when applied and do not require rinsing.

4 META- (4 methacryl oxyethyl trimellitate anhydride)-It has both hydrophobic and hydrophilic groups. Improves the adhesion strength of resins to teeth by promoting intertubular penetration, impregnation and entanglement of the methacrylate base monomer into dentinal substrates and their polymerization therein.

Steps in Composite Restoration

Oral Prophylaxis

- Done to remove plaque, debris and stain from the tooth surface for efficient bonding.
- Non-fluoride paste should be used, as the surface becomes more acid resistant with fluoride.
- Glycerin should not be used as it provides an impervious layer.

Shade Selection

- It is done prior to rubber dam application.
- Light source used- should be natural mid day light coming from the northern sky and slightly overcasted. If artificial light is used white fluorescent light is preferred.

- The eye of the operator and the tooth should be at the same level, and the operator should stand at a distance of not more than 3 feet.
- Hue – It is the main color, E.g red, yellow etc CHROMA is the depth of the colour – how far it is red, VALUE – darkness or whiteness of the color –shade
- Shade is also compared with the hair, pupil and skin color.

Beveling of the Cavity Border

- Bevel of 45° is given at the cavity border extending for 1-1.5 mm.
- It is done to increase the surface area available for bonding and to provide a gradual reduction in the material thickness and also helps in color blending with the tooth.

Acid Etching

- 37% (30-50%) orthophosphoric acid is commonly used for 15 secs. Others are 50% citric acid or 25% pyruvic acid.
- Available in gel and liquid form.
- Liquid- used for pit and fissure sealant and requires constant replenishing.
- Gel – is used in small areas, easy to control and rinsing time required is more.
- Etching cleans the tooth surface, increases the surface free energy by increasing the wettability, increases the surface area by formation of micropores, removes smear layer, opens dentinal tubules, increases dentinal permeability and decalcifies the inter and peritubular dentin.
- Problems encountered in deciduous teeth are- presence of outer prismless layer and increased organic content. Methods of improving bonding are- increased etching time, washing and re-etching, mechanical removal of the 0.1mm of prismless layer or use of coupling agent like butyl acrylate-acrylic acid copolymer in alcohol solution.
- Depth of decalcification is affected by –pH, concentration, viscosity and time of application.



- Changes seen - 10μ loss at the surface followed by 20μ qualitative porous zone and the last zone is 20μ quantitative porous zone.
- Pattern seen – type I honey comb appearance, type II cobble stone, type III combination and type IV seen on the cervical region where there is loss of surface layer without formation of micropores due to failure of the enamel rods to extend upto the surface. (prismless layer is seen on deciduous enamel, cervical portion and pit and fissure of permanent teeth).

Finishing and Polishing of Composites

It should be kept to the minimum, aimed at providing the final contour and smooth finish. Care must be exercised with all rotary instruments to prevent damage to the tooth structure especially at the gingival marginal areas.

Finishing and Polishing

Carbide finishing bur is used to remove excess composite. Medium speed with light intermittent brush strokes and air coolant for contouring is used. Final polishing is achieved with rubber polishing paste. Sand paper disc can also be used with low speed and by constant shifting motion. Final polishing is done with a fine grit disc available in different sizes.

Wear of Composites

1. Microfracture theory- Filler particles are compressed onto the adjacent matrix during occlusal loading, creating microfractures in the weaker matrix. These microfractures may unite and lead to the loss of the surface layer of composite.
2. Hydrolysis theory – Debonding between the filler particle and matrix as the silane bond is hydrolytically unstable leading to loss of surface fillers.
3. Chemical degradation theory – Materials from food and saliva are absorbed into the matrix, causing matrix degradation and sloughing from the surface.
4. Protection theory – Weak matrix is eroded between particles.

Repair of Composites

Rebonding to Old Composite

Replacement of composite restorations becomes necessary following fracture of old restoration. The tooth should be cleaned with pumice and etched before placing the bonding agent and the material. Rebonding is achieved by a combination of new tag formation and chemical bond between the new composite and residual tags.

Repair of the Newly Placed Restoration

Addition can be made directly over the restoration that has been just cured and polished.

Properties of Composite Resins

1. Setting- commences immediately after mixing in selfcure with uniform rate of set through out the bulk and limited working time. The working time is longer with light cured. These materials tend to set slowly when exposed to light. Increased viscosity- retards diffusion of active free radicals from the surface layers to the lower unactivated layers, resulting in the material that is unset.
2. Polymerization reaction is exothermic. Heat liberated can irreversibly damage the pulp if not properly insulated. For an average sized restoration the temperature rise of chemical cure composites is about $5-10^{\circ}\text{C}$ and that for light cure is $15-35^{\circ}\text{C}$.
3. Setting contraction –Increased filler, and BISGMA causes less shrinkage. TEGDMA increases shrinkage. Shrinkage compromises marginal seal and places stress on tooth substance.
4. Thermal properties – This depends on inorganic filler content. Increased filler – decreased coefficient of thermal expansion (CTE). CTE is 6-7 times more than tooth substance.
5. Mechanical properties – depends upon filler content, type and efficiency of coupling. L.C composite – compressive strength is 260 MPA.
6. Surface characteristics –Initially surface layer is rich in resin then as wear occurs relatively soft resin matrix is worn preferentially leaving the filler particles protruding from the surface.



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Chapter 13



Stainless Steel Crown

1. Introduction
2. Indications
3. Contraindications
4. Reasons for using Stainless Steel Crowns as Temporary Crowns for Permanent Teeth
5. Composition
6. Classification of Crown
7. Types of Stainless Steel Crowns Available Commercially
8. Equipments Used
9. Steps involved in Adaptation of the Preformed Stainless Steel Crown
10. Postcementation Instruction
11. Modifications of Stainless Steel Crown
12. Complications that may Develop During Stainless Steel Fabrication



INTRODUCTION

Selecting an ideal restorative material for restoration of a grossly decayed teeth is very challenging. Silver amalgam or cast crown restoration are the material of choice. Disadvantage of silver amalgam is that it requires additional reinforcement to give a truly satisfactory, long lasting results. Cast crown restoration, which avoids many of the difficulties encountered with amalgam, requires more tooth reduction and hence, cannot be used in deciduous and young permanent tooth because of the danger of pulp exposure. The advent of stainless steel crowns has been proved to be an ideal choice for such grossly decayed teeth. Introduced by **Dr. William Humphrey**, stainless steel crown provides a fast yet effective means of restoring a tooth which in the past might have had to undergo either extraction or painstaking and laborious procedures for receiving a casting or extensive restoration of silver amalgam. Retention of a stainless steel crown depends primarily on a tight fit at the gingival margins and the shape of the preparation is relatively not important.

INDICATIONS OF STAINLESS STEEL CROWN RESTORATIONS

1. *Extensive Caries* (Fig. 13.1):
 - C1 II cavity where one or more cusps are destroyed or weakened by caries.
 - Caries involving 3 or more surfaces
 - Rampant caries.
2. *Following Pulp Therapy*: The tooth becomes brittle and weakened following pulp therapy leading to fracture especially in mesiodistal direction leading to extraction. Thus a stainless steel crown should be routinely used following pulp therapy.
3. *Developmental Defects* (Fig. 13.2): In amelogenesis imperfecta, dentinogenesis imperfecta or enamel hypoplasia, the enamel is chipped or worn off exposing the underlying dentin, which may also lead to reduction in vertical height of the crown. Cast crown is avoided, considering the pulpal morphology and reduced height of the tooth. Care must be taken while placing a stainless steel crown as enamel easily

chips off. Usually when the patient reports for the first time, much of the tooth would have worn off, leading to reduced vertical height. To restore the normal vertical dimensions, it may necessitate placement of the crown with increased occlusogingival dimensions. To prevent undue discomfort to the patient, crowns should be placed in pairs one on each side of the mouth, either in the same arch or the opposite arch.

4. *Bruxism*: Stainless steel crown can be given to compensate for the wear and to reduce the masticatory forces on the erupting permanent teeth.
5. *Fractured Incisors*: Stainless steel crown can be given as temporary restorative material which provides a means for retaining sedative dressing over the exposed dentin.
6. *Abutment for Space Maintainer* (Fig. 13.3): As in crown and loop space maintainer, used where band placement is difficult due to reduced undercut as in first deciduous molar or when the abutment undergoes pulp therapy.
7. *Handicapped Children*: Oral hygiene maintenance is difficult, so stainless steel crowns are preferred to restore carious tooth than amalgam restorations.
8. *Others*: As in habit breaking appliance, in the management of recurrent caries around existing restorations and as abutment to a prosthesis.

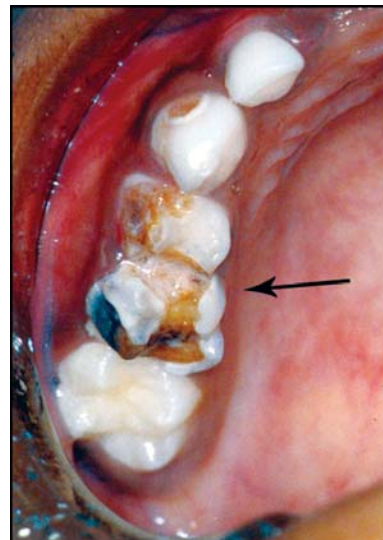


Fig. 13.1: Caries involving 3 or more surfaces indicated for stainless steel crown restoration



Fig. 13.2: Teeth with developmental defects indicated for stainless steel restoration



Fig. 13.3: Crown and loop spacemaintainer

CONTRAINDICATIONS TO STAINLESS STEEL CROWN RESTORATION

1. As a permanent restoration in a permanent dentition
2. Deciduous teeth that exhibits resorption of $> \frac{1}{2}$ of the root length.

Stainless steel crowns are used as temporary crowns for permanent teeth because:

1. The margins of the crowns cannot be made as accurate as gold and other materials, which can be adapted for marginal excellence

2. They are not as durable for a long period as crowns made of precious metal.

COMPOSITION

1. Stainless steel crowns (18-8)
2. *Nickel based crowns:* They contain Nickel (72%), Chromium (14%), Fe (6-10%), Carbon (0.04%), Manganese (0.35%) and Silicon (0.2%). These crowns are very easy to adapt and have increased wear resistance.

Stainless steel : 12-30% chromium is added to steel alloy (steel=carbon in iron)
 : 18-8 alloy contains 18% chromium and 8% nickel
 : Strength: 211-1760 Mpa
 : They resist tarnish and corrosion due to the formation of passivating layer of chromium oxide (Cr_2O_3)
 : There are 3 types of steel: ferritic, martensitic and austenitic

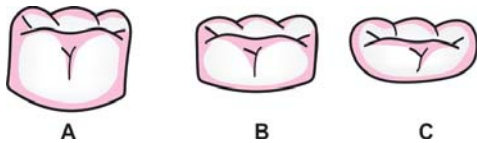
Austenitic is preferred to ferretic because:

- Increased ductility and ability to be cold worked without fracturing
- Strengthening during cold working
- Greater ease of welding
- Ability to overcome sensitization ($>650^\circ\text{C}$)
- Less critical grain growth, during annealing

CLASSIFICATION OF CROWNS

Classification of Crown Based on Shape (Figs 13.4A to C)

1. *Untrimmed:* They are long and usually requires trimming
2. *Pretrimmed (pre festooned):* These crowns are short in length but are not contoured and so has a parallel sides
3. *Precontoured:* These crowns are contoured and have a bell shape.



Figs 13.4A to C: Types of crown based on shape; A: Untrimmed crown; B: Pretrimmed crown; C: Precontoured crown

TYPES OF STAINLESS STEEL CROWNS AVAILABLE COMMERCIALY

Four basic types of crowns are:

1. Rocky mountain
2. Ormco company
3. Unitek
4. 3M company.

Rocky Mountain

- It is not prefestooned and requires trimming at the gingival margins
- Occlusal table is small buccolingually and this crown is more easily dislodged if there is any interference
- Made of 18-8 steel.

Ormco Company

- It is prefestooned with broader occlusal table and long gingival occlusal height
- May require additional gingival trimming
- It has prominent marginal ridge and can also be dislodged due to interference
- Will provide an excellent restoration if properly belled and trimmed.

Unitek

- It is a variant of rocky mountain and Ormco company
- It is prefestooned
- Shallow cuspal angles, preventing lateral excursion
- Rounded cusps
- Broader occlusal table buccolingually and thus requires less tooth reduction
- Causes minimum interference with opposing teeth
- 18-8 steel.

3M Company

- It is nickel based crown
- Made of nickel chromium alloy, containing nickel (70%), chromium (15%) and ferrous (10%)
- Height is similar to pretrimmed crown and are precontoured making them rounded
- Easy to fit and require least amount of additional crimping, trimming and countouring.

EQUIPMENTS USED

Burs (Figs 13.5A to D)

Round – For caries removal

Flame shaped diamond bur: For occlusal reduction

Long thin tapered diamond bur: For proximal, buccal and lingual reduction.

Rubber wheel or point / green stone – for finishing and polishing.

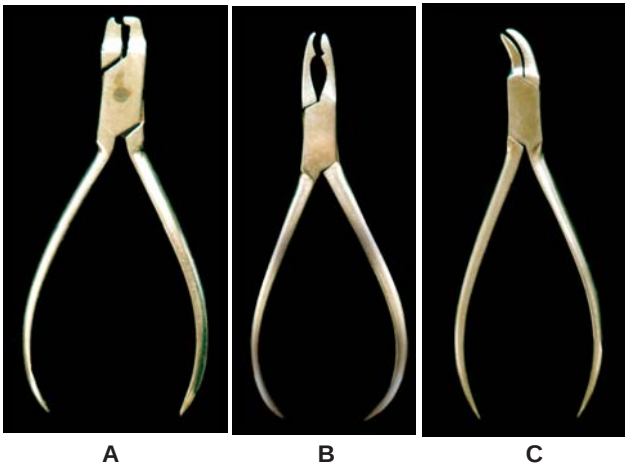
Pliers (Figs 13.6A to C)

Johnson No.114 (Rocky mountain) – for general contouring in the occlusal and middle region No. 417 (Unitek) crimping pliers – to produce marked curvature in cervical region.



Figs 13.5A to D: Diamond burs used for tooth reduction for stainless steel crown restoration. Flame shaped and long thin tapered bur are routinely used: (A): Flame shaped bur; (B): Round end tapered bur; (C): Flat end tapered bur; (D): Long thin tapered bur

Figs 13.5A to D: Diamond burs used for tooth reduction for stainless steel crown restoration. Flame shaped and long thin tapered bur are routinely used: (A): Flame shaped bur; (B): Round end tapered bur; (C): Flat end tapered bur; (D): Long thin tapered bur



Figs 13.6A to C: Pliers used for fabrication of stainless steel Crown; A: Crimping pliers; B: Johnson ball and socket plier, used to get a bell shaped contouring ; C: Gordon plier, used for general contouring and shaping

No. 112 (Dentatum) – to produce convexity and contact points.

No. 137 Gordon- used for general contouring and shaping.

STEPS INVOLVED IN ADAPTATION OF THE PREFORMED STAINLESS STEEL CROWN

1. Crown selection
2. Preoperative occlusal evaluation
3. LA administration
4. Rubberdam application
5. Placement of wedges
6. Tooth preparation
 - Occlusal reduction
 - Proximal reduction
 - Buccal and lingual reduction
 - Finishing
7. Trial fitting, trimming and contouring the crown
8. Finishing the crown
9. Cementation
10. Postcementation instruction.

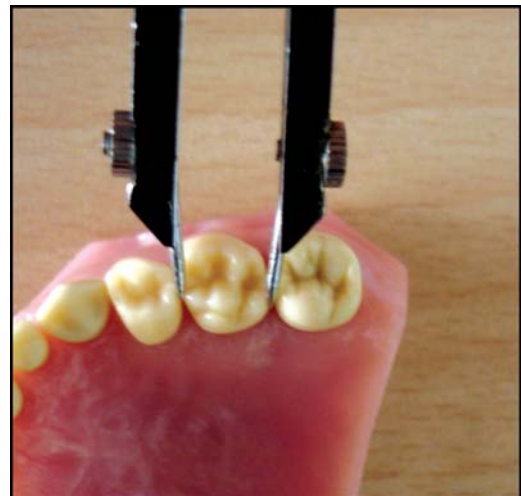
Crown Selection

A correctly selected crown should cover all the tooth preparation and provide resistance to removal. Festooned crowns are superior because it most accurately reproduces the tooth morphology and

requires least trimming and contouring. Primary molar with deep interproximal caries extending subgingivally may warrant the use of non-festooned crown to encompass the margins of the preparation.

The Factors To Be Considered During Crown Selection

Mesiodistal Width of the Tooth: Preoperative mesiodistal width of the tooth to be crowned is measured with the callipers and matched with the stainless steel crown (Figs 13.7A and B). The crown selected should be of correct dimensions as a smaller crown will have no allowance



A



B

Figs 13.7A and B: Measurement of the mesiodistal width of the crown; A: Mesiodistal width of the tooth is measured first with a divider; B: The measurement is compared with the mesiodistal width of the crown



for contouring and on the other hand it will be impossible to contour satisfactorily a grossly over sized crown. It should be also kept in mind that an over contoured or oversized crowns on 2nd deciduous molar can prevent normal eruption of the 1st permanent molars.

Occlusal Anatomy (Figs 13.8A and B): Excessive occlusal anatomy may present with problems. Deep occlusal fissures and high cusps means that a greater reduction of the occlusal surface is required to avoid problems occurring when the crown is fitted. Such crowns without adequate reduction may not reach the correct gingival level and will rock.



A



B

Figs 13.8A and B: Occlusal anatomy of the crowns; A: Maxillary first and second deciduous molar crowns; B: Mandibular first and second deciduous molar crowns

Height of the Crown (Figs 13.9A and B): The height of the crown should be same as that of the uncut tooth with cervical margin not more than 1mm. below and parallel to the gingival margin.

Primate Space: Preoperative assessment of the presence or absence of primate space should be done, when 1st deciduous molar is crowned. Impingement of this space may prevent early mesial shift of the 1st permanent molar.

Gingival Marginal Contour: The shape and contour of gingival margins differs from the 1st to 2nd molar as well from buccal to lingual to proximal aspect. Three



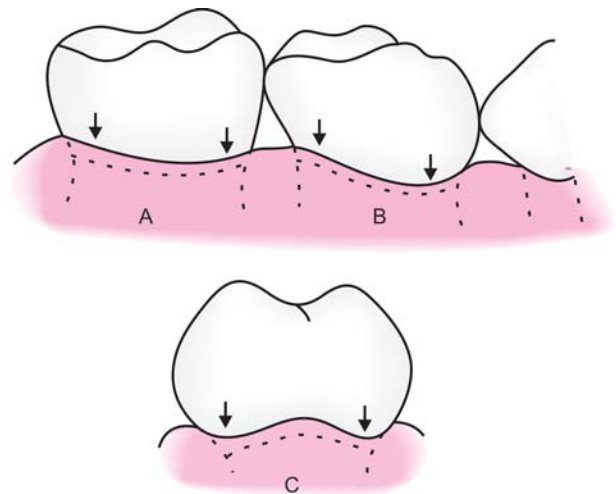
A



B

Figs 13.9A and B: Measurement of the height of the crown; A: Height of the tooth is made first with a divider; B: The measurement is compared with the height of the crown

forms of gingival margin contour has been described as 'Smile', 'Stretched S' and 'Frown' (Figs 13.10A to C and 13.11).



Figs 13.10A to C: Diagrammatic representation of the gingival contour line. Dotted line denotes cervical margin of the crown; A: 'Smile'; B: 'Stretched S'; C: 'Frown'

"Smile": The outline of the buccal gingiva of the second deciduous molar and the lingual gingiva of both the deciduous molars resemble a smile.



“Stretched S”: Owing to the mesiobuccal cervical bulge, the gingival margin dips down in the buccal aspect of 1st deciduous molar as it continues from distal to mesial giving the configuration of a ‘S’ that has been stretched on one side.

“Frown”: Due to short occlusocervical height at the mid point on the proximal aspect the gingiva dips down on either side of this midpoint giving a frown line.

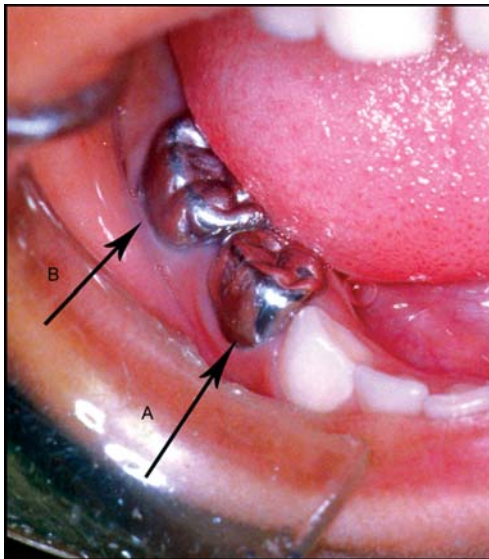


Fig. 13.11: Gingival contour line; A: Stretched ‘S’ contour on the first molar; B: ‘Smile’ contour on the second molar; C: ‘Frown’ contour on the proximal aspect

Preoperative Occlusal Evaluation

An instrument (probe) should be placed on the operating tooth so that the probe extends and touches the cusps of the two adjacent teeth (Fig. 13.12). This helps in later evaluation of the reduction and crown fit.

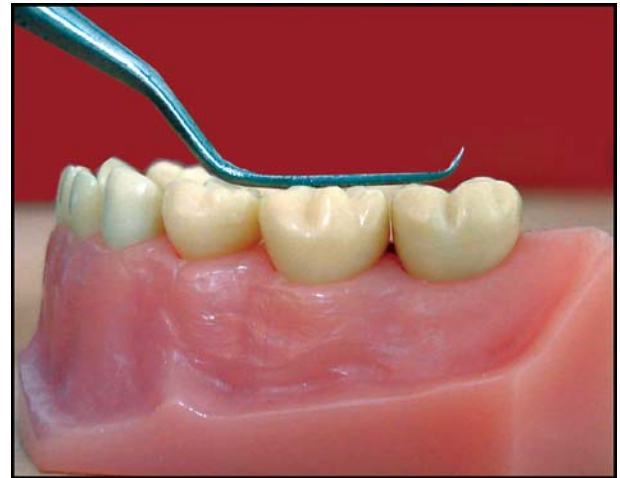


Fig. 13.12: Preoperative occlusal evaluation

Local Anesthesia Administration

Local anesthesia reduces the discomfort to the patient during tooth reduction and crown manipulation.

Rubberdam Application

It prevents slipping of crown into the throat accidentally and also provides isolation if tooth has to undergo pulp therapy.

Placement of Wedges

They are placed in the interproximal space which acts as tooth separators and also protects the underlying soft tissues.

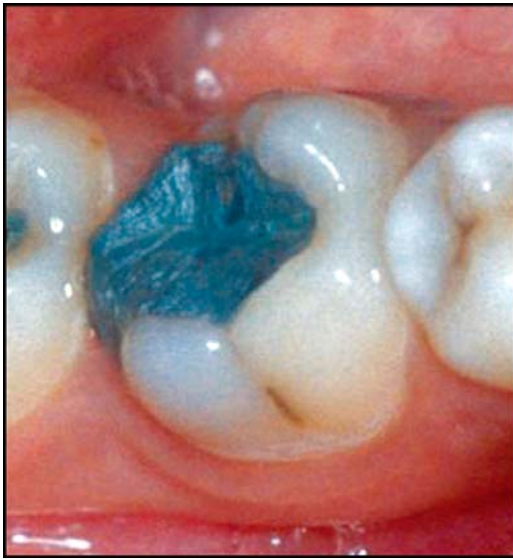
Tooth Preparation (Figs 13.13A and B)

Uniform occlusal reduction of 1.5-2.0 mm using depth guiding grooves has been recommended.

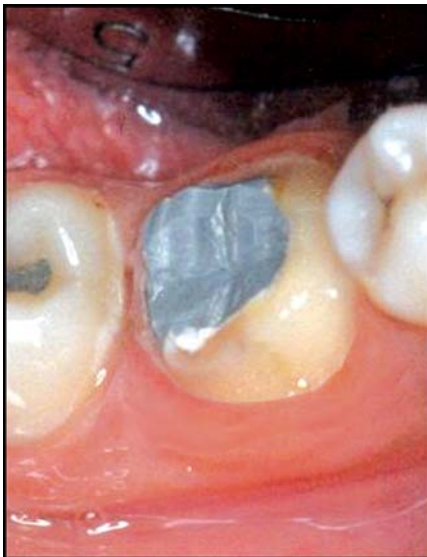
Timing of reduction of occlusal surface relative to proximal surface has resulted in wide range of views. According to Troutman (1976) occlusal reduction should be done first followed by proximal. But Kennedy suggests proximal reduction should be followed by occlusal reduction.

Occlusal Reduction

Large round bur, tapered fissure or flame shaped diamond can be used depending on the preference of the operator. The occlusal reduction of 1.5-2.0 mm follows the anatomy of the occlusal surface. Initial placement of 1 mm depth grooves in the occlusal surface



A



B

Figs 13.13A and B: Tooth preparation for stainless steel crown restoration; A: Prereduction; B: Postreduction

followed by removal of remaining portion according to cuspal inclines makes the reduction easier and accurate. Sharp line angles should be rounded.

Proximal Reduction

The tapered fissure bur is used to reduce the trauma to soft tissues. The bur is moved in a buccolingual direction starting at the occlusal surface 1-2 mm away from the adjacent tooth, until the contact area clears gingivally and buccolingually. The gingivo proximal line angle should have a feather edge finish line.

Buccal and Lingual Reduction

Minimal but adequate buccal and lingual reduction is necessary. The buccal and lingual cervical bulges can be left uncut if they do not interfere in the placement of the crown.

Finishing

All the line angles must be rounded. The occlusobuccal and occlusolingual line angles are rounded by holding the bur at a 30-45° angle to the occlusal surface and sweeping it in a mesiodistal direction.

Trial Fitting, Trimming and Contouring the Crown (Figs 13.14 to 13.16)

The purpose of crown trimming and contouring are respectively to leave the crown margins in the gingival sulcus and to reproduce the tooth's morphology.

Seating of a crown on a mandibular molar is best done by first fitting the lingual side and then rotating it buccally. In the upper arch it is easier to fit the buccal side first. The position of the gingival margin is marked on the crown, to have the cervical margin of the crown parallel to the gingival margin and extending 1mm subgingivally. The excess material is cut with curved crown and bridge scissors away from the patient taking care that the slivers of the steel does not injure the patient. The margins are smoothened using a green stone. The crown is then contoured using a 114 plier and crimping plier resulting in a smooth flowing outline on the margin of the crown. The crown should snap into place when refitted. Care should be taken to see that there is no gingival blanching and no occlusal interference.



Fig. 13.14: Position of the plier during contouring



Fig. 13.15: Position of the plier during crimping

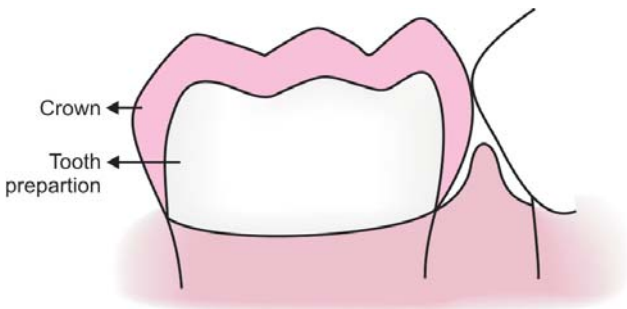


Fig. 13.16: Knife edge margin in the tooth preparation and fit of a stainless steel crown

Finishing the Crown

It includes making of a bevel on the external surface of the crown margin around the entire periphery using a green stone held at 45° angle to the margin to reduce a feather edge margin. Final finishing is done with stone and rubber wheel to remove scratches and obtain shine.

Cementation

Cements used are ZnOE, ZnPO₄, polycarboxylate, glass ionomer cement. Glass ionomer is superior to all the above, while ZnOE is the least preferred.

Debris and hemorrhagic material are removed from the tooth surface by flushing with copious amounts of warm water. The tooth is isolated with cotton. All exposed

dentin surface is protected with several layers of varnish. The crown is 1/2- 2/3 filled with cement that has been mixed to the luting consistency. The crown is seated on the tooth along the pre determined path of insertion. The cotton rolls are removed promptly and the patient requested to bite gently on the crown to ensure its being forced to place. The end of a tongue depressor, trimmed to the mesio distal size of the crown is placed between the crown and opposing tooth and the patient is asked to occlude gently. When the cement has been half set, the tongue depressor is removed, the occlusion is rechecked and excess cement is removed using scaler from the buccal and lingual aspects and floss can be used for proximal surface (Fig. 13.17).

Luting Material	Film Thickness μm	Setting time Min.	Compressive Strength Mpa
ZnPO ₄	18	5.5	103.5
ZnOE	25	4-10	27.6
Poly carboxylate	21	5.5	55.2
Glass ionomer	24	6.5	86.2



Fig. 13.17: Final placement of a stainless steel crown

Postcementation Instruction

The patient should be instructed to avoid heavy chewing with the crown for 24 hours. Instructions should be given for maintaining oral hygiene and should be recalled once every 6 months for evaluation.

MODIFICATIONS OF STAINLESS STEEL CROWN

- A. When more than one stainless steel crown has to be prepared additional factors to be remembered are –



- i. Occlusal reduction of one tooth should be done completely before starting the second tooth. If done together there is a tendency to over reduce.
 - ii. Contact point between adjacent teeth should be broken producing 1.5 mm space at the gingival level.
 - iii. Both crowns should be trimmed, contoured and prepared for cementation simultaneously. Cementation of the distal tooth is done first and should be the same as during trial fitting.
- B. *Drifting of tooth and space loss*: The crown required to fit a tilted tooth buccolingually will be too wide mesiodistally and crown selected to fit mesiodistally will be too small buccolingually. In such a case larger crown is taken and mesiodistal width is adjusted by using Howe utility plier. Alternate method when there is space loss is by using the crown of diagonally opposite arch.
- C. *Undersized crown* (Fig. 13.18A): A vertical cut is made on the buccal surface of the crown. The margins are pulled apart and an additional piece of steel band material is spot welded to the buccal surface increasing the dimensions of the crown. After contouring, the crown is soldered, polished and cemented.
- D. *Over sized crown* (Fig. 13.18B): The crown is cut vertically along the buccal wall. The free crown margin are approximated and overlapped over each other spot welded to reduce the crowns dimension. After contouring, the cut and relocated area is soldered and polished.
- E. *Deep subgingival caries in the interproximal surface* (Fig.13.19): This can be managed by 2 methods-use of unfestooned crown or a modified prefestooned crown. A normal prefestooned crown can be used by spot welding an additional band piece thus increasing the length of the crown wherever required.
- F. *Open contact (except the primate space)*: It can be corrected by using larger crown, taking care not to disturb the path of eruption of the erupting adjusting tooth. Contouring can also be done using 112 ball and socket plier if the gap is little. Localized addition of solder is also recommended.

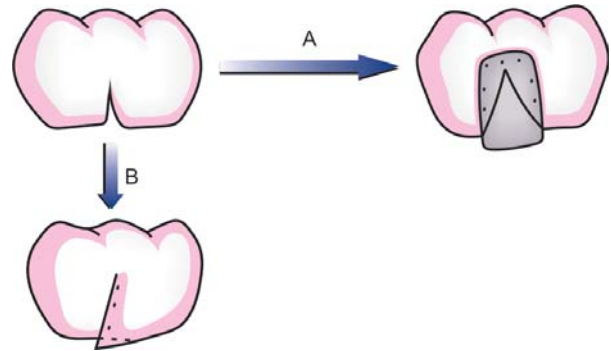


Fig. 13.18: Management of ; A: Undersized crown; B: Over sized crown

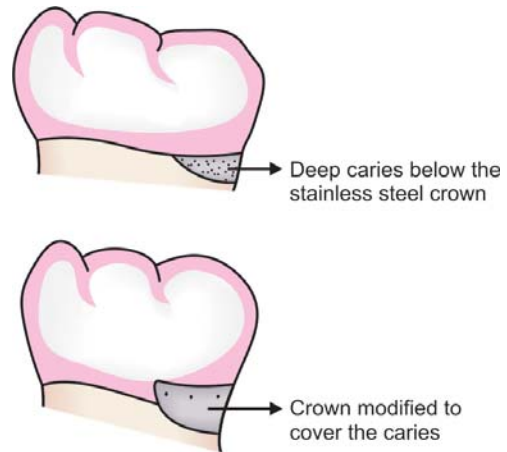


Fig. 13.19: Extension of stainless steel crown into the deep subgingival caries in the interproximal surface

- G. *Anterior teeth*: Due to its strength and stability stainless steel crowns are preferred in grossly destroyed anterior teeth. Poor esthetics of stainless steel crowns can be improved by removing a portion of the labial surface of the crown or replacing it with a layer of composite resin. These crowns are also used in the correction of anterior cross bite, where the crown is cemented backwards to provide an inclined plane in the bite.
- H. *In bruxism*: When there is greater risk of crown wear on the occlusal surface, the thickness of the metal on the occlusal surface can be increased by the addition of a layer of solder from the impression surface of the crown. This is known as Croll's technique.



COMPLICATIONS THAT MAY DEVELOP DURING STAINLESS STEEL FABRICATION

- A. *Formation of interproximal ledge*—Leads to inability to seat the crown.
- B. *Over extension of the crown*—This can be identified by the gingival blanching (Fig.13.20) and can lead to loss of attachment and periodontal injury.

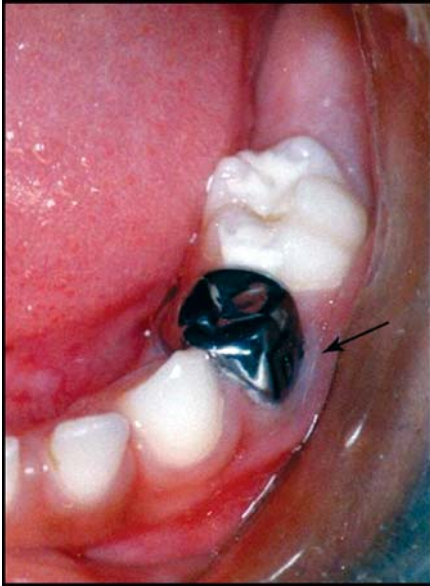


Fig. 13.20: Gingival blanching seen due to overextension of the crown (Arrow)

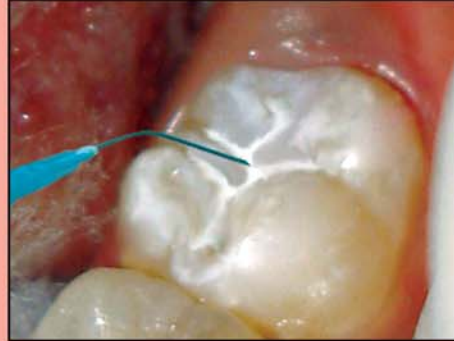
- C. *Under extension of the crown*—This will expose the tooth surface above the free gingival margin, making the area vulnerable for debris and plaque collection leading to caries formation and microleakage.
- D. *Ingestion of crown*—Can be overcome by using a square piece of gauze as throat screen or by using rubberdam. Should this happen PA chest radiograph is mandatory and patient is referred to the physician. If the crown is not found in the radiograph it is assumed to pass uneventfully through the alimentary tract within 5-10 days and parents are advised to keep a constant check. If not found abdominal X-ray is necessary to locate the crown.

- E. Failure results from poor and inadequate preparation and improper gingival adaptation.

FURTHER READING

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Chapter 14



Preventive Dentistry

1. Introduction
2. Principles, Objectives and Scope
3. Minimal Intervention Dentistry
 - Concept of Identification:
 - Evaluation of saliva
 - Caries activity tests
 - Assessing the occlusion and tooth factor
 - Understanding the patients environment such as socioeconomic status, the health and education status, etc.
 - Diet analysis and counseling
 - Concept of Prevention:
 - Combating caries inducing microorganisms
 - Modifying caries promoting ingredients of diet
 - Use of sugar substitutes
 - Increasing the resistance of teeth to decay
- Concept of Control:
 - Ozone Application
- Preventive Resin Restoration (PRR)
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4. Levels of Prevention
5. Health Education
6. School Dental Health Program
7. Oral Hygiene Aids
8. Tooth Brushing Program for Children
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INTRODUCTION

Preventive Dentistry has been defined as “The efforts which are made to maintain normal development, physiologic function and to prevent diseases of the mouth and adjacent parts”.

According to WHO expert committee, prevention denotes a procedure or course of action that prevents the onset of disease.

PRINCIPLES AND OBJECTIVES OF PREVENTIVE DENTISTRY

1. To influence the lifestyle of individuals, families and communities, so that oral health is promoted or maintained.
2. To make provision of required treatment available to those individuals who have developed oral disease, so that the disease process is arrested at the earliest and loss of function is prevented.
3. To make children loose fear of dental procedures by education, experience and conscious efforts of care providers.

SCOPE

The main emphasis of modern oral health care practice is prevention of dental disease. This is because:

1. Dental diseases are common
2. Incidence of dental disease is on an increase
3. Primary prevention of dental diseases is possible due to sufficient knowledge of etiopathology and epidemiology
4. Most of the dental disease are initially symptom less
5. Secondary prevention of dental disease is also possible
6. Dental diseases are not self curing.

MINIMAL INTERVENTION DENTISTRY

The concept of minimal intervention dentistry (MID) has evolved as a consequence of our increased understanding of the caries process and the development of adhesive restorative materials.

Caries is now not treated just as a symptom but as a disease. Hence a medical approach is instituted which includes caries risk assessment besides restoration of the cavity.

Minimal invasive treatment or minimal invasive dentistry or microdentistry all form the minimal intervention dentistry. It is concerned with ultra conservation treatment of infected and affected oral tissues and aimed at preserving maximum amount of oral tissues by providing least invasive intervention often regarded by patient's as painless and atraumatic. It also aims at management of caries through risk assessment (CAMBRA, acronym used for “caries management by risk assessment”).

Aim's and Objectives of Minimal Intervention Dentistry

1. The disease should be treated first
2. The surgical approach should be undertaken only as a last resort, with minimal removal of natural tooth material
3. Management begins with identification and elimination of the disease
4. Restoration per se will not prevent or eliminate disease
5. Caries is a bacterial infection and until the microflora is controlled the risk of further demineralization in the remaining tooth structure continues.

Concepts of Minimal Intervention Dentistry

A new and fresh concept towards management of caries is that the restoration of a tooth becomes the last treatment decision rather than the first consideration as at present.

The three main concepts of MID are:

1. Identification
2. Prevention
3. Control

Concept of Identification

The concept of identification is to identify people at high risk for dental disease. It is aimed at risk assessment and creating awareness which forms the first step in the management of disease. It includes

- Evaluation of saliva



- Evaluation of caries activity (Caries activity tests)
- Assessing the occlusion and tooth factor
- Understanding the patients environment such as socioeconomic status, education status, etc.
- Health and education
- Diet analysis and counseling.

Concept of Prevention

Prevention of caries forms the next phase by formulating plans to check the etiological factors. The 3 part strategy developed to prevent caries include

- A. Combating caries inducing microorganisms
- B. Modifying caries promoting ingredients of diet and use of sugar substitutes
- C. Increasing the resistance of teeth to decay

Combating caries inducing microorganisms: This can be done by various methods such as:

- *The bisguanide antiseptics, chlorhexidine:* At high concentration it acts as a detergent damaging the cell membrane and causing the loss of cytoplasmic constituents. At low concentrations it inhibits sugar transport and glycolytic rate and membrane bound ATPase activity.
- *Triclosan:* It is a nonionic antibacterial agent against gram +ve bacteria. It is compatible with fluoride and hence can be used in dentrifices.
- *Delmophinol hydrochloride:* It is a highly surface active substance which has shown to reduce the amount of plaque formation.
- *Caries vaccine:* It can be active or passive immunization. But it is of less significance due to the involvement of many bacteria and factors in the etiology of caries.
- *Replacement therapy:* In this method cariogenic bacteria are replaced by noncariogenic bacteria. But practically it is difficult to achieve.
- *Blocking plaque build up:* Studies are going on to produce substances that inhibit glucosyl transferase,

interfere with the adhesion and coaggregation of bacteria and an effective antibacterial agent.

Modifying caries promoting ingredients of diet

- Addition of preservatives with enhanced antibacterial activity.
- Addition of natural demineralization inhibitors.
- Increased consumption of protective food components such as polyphenols in chocolates, oat hulls, cheese and milk. The calcium phosphate complexes of casein phosphopeptides in the milk has shown to have a very anticaries effect by increasing the level of CaPO_4 in plaque resulting in reduced enamel demineralization and enhancement of remineralization. These calcium phosphopeptides can be incorporated into the dentifrices and other fluoride containing dental products. It is said to enhance the effects of fluoride in remineralization.

Increasing the resistance of teeth to decay

- Use of fluorides and pit and fissure sealants.
- Remineralizing agents like amorphous calcium phosphate, combination of tetra calcium phosphate and dicalcium phosphate anhydrous, used along with fluoride gives better results.
- Polymeric coating consisting of coating the tooth surface with monomer and polymer.
- Laser: The ability of the laser to alter the surface of enamel and increase its resistance to acid challenge is utilized. The CO_2 laser is efficiently absorbed by the tooth minerals and is transformed rapidly into heat and forms a ceramic like surface that is highly resistant to acid attack. Laser treatment appears to be particularly useful for treatment of pit and fissure surfaces.
- Augmenting host resistance- protective system in saliva can be produced by recombinant DNA technology.



Commonly Used Lasers in Dentistry

CO₂ LASER

- Gas active medium
- Delivery through a hollow tube like wave guide in continuous or gated pulse mode
- Wavelength-10,600nm
- Well absorbed by water, rapid soft tissue removal and shallow penetration in to tissue hence used for mucosal disorder
- High affinity for hydroxyapatite almost 1000 times more than erbium
- Used in non contact manner for tissue ablation

Er: YAG:

- A solid crystal of yttrium aluminum-garnet doped
- Wavelength-2940nm
- Delivery system-fiberoptically in free running pulse mode
- Uses - caries removal cavity preparation, hard and soft tissue modifications

Nd: YAG LASER

- Solid medium such as a crystal of yttrium - aluminium and garnet doped with neodymium is used
- Delivery system is fibroptic system in free running pulsed mode
- 1st laser designed exclusively for dentistry
- Wavelength-1045nm
- Highly absorbed by pigmented tissue and 1000 times more absorbed by water than argon laser
- Less interaction with sound dental tissue
- Can destroys the cariogenic lesions without removing sound enamel

Diaode LASER

- Delivery system-fiberoptically in continuous wave or gated pulse
- Portable machine that is quite and produces less or no heat
- Wavelength-800-980nm
- Well absorbed by soft tissue and poorly absorbed by hard tissue

Argon LASER

- Medium - Argon gas
- Delivery system - fibroptic in continuous and gated pulse
- Wavelength - 488nm and 514nm
- 488nm - visible, blue in color used for curing of composite with shorter curing time 5-10sec can be used in night activated impression paste and light activated bleaching gels
- 514 nm - visible, green - blue in color. Absorbed by red pigment like hemoglobin, hemosiderin and melanin, can be used as surgical laser with excellent hemostatic capabilities during the treatment of periodontal diseases and vascularized lesions

Biolase water LASER

- Developed in 1998, october
- The biolase waterlaser uses a process which gently washes away decay with laser-energized water droplets.
- Hydrokinetic energy is produced by combining a spray of atomized water with laser energy.
- The result is the energized water gently and precisely removes a wide range of tissue including tooth enamel, and soft tissue (gum tissue) with no heat or discomfort in most cases
- Used to remove decay from teeth, perform conservative tooth preparation, treat sensitive teeth, reshape gum tissue for a more cosmetic appearance, treat apthous ulcers and fever blisters, eliminate bacteria in periodontal pockets and enhance the bonding of tooth colored fillings to teeth.



Concept of Control

It aims at treatment of caries and maintenance of restored tooth. Restoration or treatment of caries is aimed at removing only the active caries where remineralization is not possible. The tooth is then restored with an adhesive fluoride releasing material. Continued professional oral prophylaxis is important to maintain the restoration in good condition to reduce the risk of secondary caries.

Special means of caries control includes:

- **Ozone Application:** it interferes with the metabolism of bacterial cell, most likely by inhibiting and blocking the operation of the enzymatic control system. A sufficient amount of tri-atomic oxygen breaks through the cell membrane and this leads to the destruction of the bacteria. On this basis minimal invasive and less threatening dental treatment is possible through ozone exposure.
- Preventive Resin Restoration (PRR)
- Atraumatic Restorative Technique (ART)

Minimal Intervention Dentistry

Identification	— Caries Activity Tests
	— Saliva Analysis
	— Eliminating the Tooth Factor
	— Understanding Patients
	— Environment
Prevention	— Combating Microorganisms (Chlorhexidine, Triclosan)
	— Diet analysis and Counseling
	— Use of Sugar Substitutes
	— Increase the Resistance of Teeth to Decay (Fluorides, Pit and Fissure Sealants, Laser)
Control	— Ozone Treatment
	— Preventive Resin Restoration
	— Atraumatic Restorative Technique

CARIES ACTIVITY TESTS

Caries activity is defined as the speed with which teeth are destroyed by caries, which includes new carious lesions and enlargement of the existing cavities during

a certain period. Accurate analysis of the activity is important for treatment planning, selection of restorative material and recall appointments and for initiating preventive procedures.

Ideal Requisites of a Caries Activity Test

- Should have a sound theoretical basis
- Show maximal correlation with clinical status
- Be accurate with respect to duplication of results
- Be simple
- Be inexpensive
- Take less time to perform
- Should possess validity, reliability and feasibility

1. Caries activity test means measuring the level of activity of bacteria for producing caries. e.g., Lactobacillus colony count, Snyder test
2. Caries susceptibility test means measuring the level of vulnerability of host for caries activity. e.g., Salivary reductase test, Buffer capacity test
But both are routinely referred to as caries activity tests.

Some of the Caries Activity Tests

1. Lactobacillus colony count
2. Snyder test
3. Salivary reductase test
4. Saliva tongue blade method
5. Rapid caries activity test by resazurin disc.

Lactobacillus Colony Count

- Introduced by Hadley in 1933
- It estimates the number of acidogenic and aciduric bacteria in patient's saliva, done by counting the number of colonies appearing on tomato peptone agar plates or Rogosa's medium.
- Saliva is collected after having the patient chew paraffin before breakfast.
- Saliva is diluted to 1:100 dilution
- 0.4 ml of this is spread on the surface of an agar plate and are incubated at 37°C for 3-4 days
- A count of the number of colonies is then made by using Quebec counter.

**Disadvantages**

- Results are available after few days
- Counting the colonies is a very tedious process
- Requires complex equipments and personnel with bacteriological training
- High cost
- Repeated sampling is required

Results

Number of lactobacillus/ml	Caries activity of saliva
0-1000	Little or no activity
1000 – 5000	Slight activity
5000 – 10,000	Moderate activity
> 10,000	Marked activity

Snyder Test

- It measures the rapidity of acid formation, when a sample of stimulated saliva is inoculated into glucose agar whose pH is adjusted to 4.7-5 and with bromocresol green as color indicator
- Saliva is collected and shaken vigorously for 3 minutes
- 0.2 ml is pipetted into the tube of agar and mixed
- Agar is allowed to solidify and incubated at 37°C
- Color change of the indicator is observed after 24, 48 and 72 hours.

Advantage

- Simple
- Requires simple equipments
- Moderate cost
- Found a high correlation between the snyder test and lactobacillus count test and clinical caries activity

Results

Color Change	Time	Caries Activity
Yellow (pH < 3.8)	24 hours	Marked activity
	48 hours	Definite activity
	72 hours	Limited activity
Green (pH 5.4)	24 hours	Continue test
	48 hours	Continue test
	72 hours	Inactive

Salivary Reductase Test

- It measures the enzyme reductase in the saliva
- The test measures the rate at which an indicator dye, diazoresorcinol changes its color from blue to red to colorless on reduction by the mixed salivary flora.

- Saliva is collected by chewing a special flavoured paraffin and expectorating directly into the collection tube upto the 5 ml calibration mark
- Sample is mixed with a fixed amount of diazoresorcinol and the change in color is noted after 30 seconds and 15 minutes.

Results

Color	Time	Score	Caries activity
Blue	15 min.	1	Non conducive
Orchid	15 min.	2	Slightly conducive
Red	15 min.	3	Moderately conducive
Red	30 sec.	4	Highly conducive
Pink/white	30 sec.	5	Extremely conducive

Saliva Tongue Blade Method

- The test estimates the number of *S. mutans* in mixed paraffin stimulated saliva, when cultured on Mitis-Salivarius Bacitracin (MSB) agar medium.
- Patient chews paraffin wax for 1 min., thus displacing plaque microorganisms into the saliva
- The subjects are then given a sterile tongue blade which they rotate in their mouth ten times, so that both the sides of the tongue blades are thoroughly coated. Excess saliva is removed by withdrawing the tongue blade through closed lips.
- Both sides of the tongue blade are then pressed on to an MSB agar medium in a petridish. It is then incubated at 37°C for 48 hours.
- Counts of > 100 colony forming units (CFU by this method is proportional to greater than 10⁶ CFU of *S. mutans* per ml. of saliva by conventional methods.

Rapid Caries Activity Test by Resazurin Disc

- This method of caries activity test has a characteristic color reaction developing within 15 minutes at 32-37°C.
- The color of the disc changes from blue to bluish violet, reddish violet and then to red or colorless with saliva of the individuals
- The resazurin disc is highly sensitive to gram +ve microorganisms such as *S. mutans*, *S. mitis*, Lactobacilli and Actinomyces series.
- The color change was due to a chemical reaction (oxidation-reduction reaction) and not a pH effect



SUGAR SUBSTITUTES

It is a known fact that human beings have a weakness for sweets and also sucrose is known to be one of the etiological agents in the formation of caries. Advising people to refrain from eating sucrose is practically not possible. Hence replacements for sugar were introduced.

Sugar Substitutes can be of two Types:

- A. Non-caloric sweeteners/intense sweeteners
- B. Caloric sweeteners/nutritive sugar/sugar substitutes

Non-caloric Sweeteners

They are substances of synthetic or natural origin that tastes much sweeter than sugar weight by weight. They yield little or no energy, provide no bulk and are to be used in very small quantities in drinks or blended with sugar substitutes in foods and snacks. Their main commercial success is based on weight control and diabetic products.

Example: Saccharin, cyclamates, aspartame, etc.

Sugar Substitutes/caloric Sweeteners

They are usually carbohydrates or carbohydrate substitutes. They can be metabolized to yield energy and they add bulk to the food products.

They are equally or less sweet tasting than sucrose and require blending with intense sweeteners. Their main commercial value lies in products for the diabetics and in “safe for teeth” sweets.

Example: sorbitol, xylitol, fructose, glucose.

Ideal Sweetener Selection is Based on

- Consumer acceptance
- Consumer tolerance based on metabolic capacity
- Product should be non cariogenic

Commonly used Substitutes

1. Xylitol
2. Sorbitol
3. Saccharine
4. Cyclamates
5. Aspartame

Xylitol

- Naturally occurring in raspberries, strawberries, plums, lettuce, cauliflower, mushrooms etc
- Sweetness is similar to sucrose
- Slowly absorbed from the gastrointestinal tract
- Side effects: diarrhea due to osmotic action, predisposes to renal calculi formation, epithelial hyperplasia and neoplasia of bladder.
- Majority of the bacteria including *S.mutans* and lactobacilli do not metabolize xylitol
- Most of the chewing gums contain xylitol, and chewing them for few minutes significantly lowers the salivary and plaque level of *S. mutans*.

Sorbitol

- Naturally occurring in cherries, plums, pears, apples, berries and algae
- Sweetness is half of sucrose
- Absorbed slowly from the small intestine by passive transport mechanism.
- 1 gm of sorbitol yields 4 cal energy
- Side effects: gastric upset and acts as laxative.
- WHO recommends intake of sorbitol be limited to 150 mg/kg/day
- Practically all strains of bacteria ferment sorbitol to produce acids but the rate is very slow.
- Compared to sucrose and other carbohydrates it causes less caries, and also associated with reduced plaque accumulation
- May be added to the dentrifices due its sweetening properties and as humectant.

Saccharin

- Used widely as sugar substitute
- It is 200 times sweeter than sucrose. More than 0.1% tends to become bitter and may induce vomiting
- Side effects are rare, few cases of photosensitization and allergic reactions such as urticaria have been reported.
- Excreted in urine
- Available as tablet, liquid or in powder form
- Interferes with the growth and metabolism of *S.mutans*
- Maximum allowed dose is 1 gm/day for 155 lb person

**Cyclamates**

- Used as sodium cyclamate
- It is 30 times sweeter than sucrose
- Side effects: Minimal laxative effect. Long-term use may cause growth retardation.
- It is not fermentable by oral microorganisms

Aspartame

- 180 times more sweeter than sucrose
- Loss of sweetness on storing and cooking is the main drawback
- Should be avoided in patients with phenylketonuria, during pregnancy
- Unstable in extreme of pH changes

For a substitute to be accepted commercially it should:

- Have sufficient sweetening power
- Be nontoxic
- Be reasonably inexpensive
- Be thermostable
- Have long shelf time
- Should not react with other components of food.

DIET ASSESSMENT, ANALYZING AND COUNSELING

These form the steps involved in evaluating patients' diet and implementing a modified diet habit.

Diet Habit Assessment

The collection of information about food consumption and dietary habits is essential when relating diet to caries prevalence or incidence.

Various Methods Employed for Collection

- Food balance sheets
- Food accounts and estimated food records
- Weighing methods and duplicate portion technique
- Interview methods
- Questionnaires

The choice of method is greatly affected by the purpose of study. Diet assessment can be made for individual patients or for a large group of people.

Food balance sheets (Used only for assessment of dietary habit of a given population): It is an indirect estimate of the amounts of foods consumed by a population at a certain time, expressed as per capita consumption per year. It is obtained by dividing the total amount of food with the total amount of population of the country and correlating it with the caries frequency and sugar consumption.

Advantage: It gives a total view of the country, effective while formulating a national food program

Disadvantage: Reliability of data differs from one country to other and these data shows only the amount of food available and not consumed as food wastage is not considered. It is not useful for individual assessment.

Food accounts and estimated food records: In this method the accounts of food consumed are recorded (Table 14.1) over a certain period of time (3-7 days including weekends). It can be used by a group of people living in institutions, families or on individual basis. A person has to keep record of the amount of food taken over 3-7 days which also includes a weekend. The amount of sugar containing foods can also be written specifically.

Table 14.1: Diet chart (Sample of one day)

Time	Food eaten	Method of preparation	Quantity	Sugar
7.00 AM	Milk Chapathi Jam	Boiled With Ghee -	1 Glass 2 1 tsp	✓
10.00 AM	Lassi with Sugar Gulab Jamoon	- Fried	1 Glass + 2 tsp 2	✓
11.30 AM	Burfi	Cooked in ghee	Small bite piece	✓
1.00 PM	Rice Vegetable curry	Boiled Fried in little oil	1 Medium Bowl 1 Small Bowl	---
4.30 PM	Water Melon Juice with sugar Glucose Biscuits	— Baked	1 Glass + 2 tsp 4	✓
8.30 PM	Rice Vegetable curry	Boiled Fried in little oil	1 Medium Bowl 1 Small Bowl	---
Total Sugar Exposures = 4 per day				



Advantage: Large sample can be obtained by it and it is cheap as there is no need for trained persons

Disadvantage: May not represent a typical week, bias by the individual, just the fact that the person is maintaining the record may result in change in eating habits and accuracy depends on the reliability of the data

Weighing Methods/Duplicate Portion Technique

It is also called as recipe method or double portion method. Portion similar to those consumed are collected by the subjects and then analyzed by the investigators. Meals eaten outside the home, must also be taken into account. They are then weighed.

Advantage: It is more accurate

Disadvantage: Limited sample size, much work is involved and high cost

Interview Methods

There are two variations

- a. *Diet recall*—food consumed by people during 1-2 days is recalled (1-day or 24 hr recall)
- b. *Diet history*—questions are made on the general food patterns and habits over a longer period of time, even 1 year or more

Advantage: Large sample can be utilized as less time is consumed, cheap and direct communication is possible

Disadvantage: Attitude of the interviewer is important in decision making and one day history does not give correct data.

Questionnaires: It is similar to interview, but there is no interviewer. The individual is given questionnaires that has to be completed by tick marking the correct answer. But this requires marking only those items in the questions and other items may not be entered.

Dietary Goal at Modification

1. Restriction of the frequency of in between meal snacking
2. Reduce consumption of sugar to a maximum of 10% of the total energy intake, and increase the intake of starch and fibre containing food stuffs

3. Avoid products that contain high concentration of sugar and which are retained for long periods of times in the oral cavity such as candies and sweets or at least restrict them once a week
4. Use of sugar substitutes
5. IDA national workshop on 'oral health goals for India and strategies to achieve them by 2000 AD had suggested sugar consumption should be not more than 10 kg / person/year.

Diet Counseling

In some patients a single dietary habit may explain the high levels of caries activity, such as frequent eating of sweets or snacking at night and this can be easily corrected. In others a complex eating situation is found. The eating pattern may be characterized by snacking with virtually no ordinary satiety giving meal or a proper nutrient intake. In such cases change in basic behavior is necessary.

A change in behavior is affected by the fact that humans are neophobic. Therefore changes should be brought on slowly and gradually. The advice given should be compatible with the home environment, religion, financial status, patients medications, metabolic disorders etc.

Three Basic Stages of Behavior Change

1. Contemplation stage – patient gains insight of the fact that his / her eating habits may be associated with a disease and it has to be changed
2. Stage of behavioral change
3. Maintenance stage

Areas of Influence for Promoting Dietary Behavior Modifications

- Laws and regulation
- Cultural norms and values – use of famous personalities and value of an attractive smile
- Education, to create awareness
- Food production- reduction in the cariogenic food production and sale
- Availability of food – making healthier choice the easier choice



- Improving socioeconomic status
- Media –through advertisements
- Diet assessment and counseling

Dietary modification is synonymous with restricted intake of sugars. But such approach attracted few followers and is not practical on a public health scale. More pragmatic approach would be to encourage sugar substitution by the use of hypoacidogenic and nonacidogenic sweeteners.

Xylitol, as discussed is one of the promising dietary approach on the current scene. Xylitol chewing gum has been shown to reduce levels of *S. mutans* by altering their metabolic pathway. It also enhances remineralization and arrests dentin caries. A number of potentially effective strategies have been implemented such as use of preservatives with enhanced antibacterial activity increased use of natural inhibitors of demineralization such as various phosphates, components like polyphenols (found in chocolates) oat and pecan hulls and cheese and other bovine milk products.

PIT AND FISSURE SEALANTS

The anatomical pits and fissures of the teeth have long been recognized as susceptible areas for initiation of dental caries. Robertson wrote in 1835 that the caries potential was directly related to the shape and depth of the pits and fissures. G.V. Black noted that 43-45% of all caries occurred on the occlusal surfaces.

The national preventive dentistry demonstration program was conducted by the American fund for dental health, and it was found that occlusal caries accounted for 54% of the caries in both the optimally fluoridated and fluoride deficient communities. Ripa and coworkers reported that 94% of the DMFS score involved the pit and fissure and only 6% involved the proximal surfaces.

Caries reduction of about 92% is achieved if the sealant remains intact over the pits and fissures for a period of 5 years.

History

Hyatt, 1922 first advocated the term ‘Prophylactic Odontotomy’ and published the same in 1923. He advocated filling the fissures of teeth with silver or copper oxyphosphate cement as soon as the teeth erupted and

then later, when they completely erupted into the oral cavity a small occlusal cavity is prepared and filled with silver amalgam.

Bodecker, 1929 suggested widening the fissures mechanically so that they would be less retentive to food particles and called it as ‘Fissure Eradication’.

Gore, 1939 used polymers as sealants. He used solutions of cellulose nitrate in organic solvents to fill surface enamel made porous by action of acids in saliva.

Buonocore, 1955 observed that attachment of acrylic resin to tooth surface was greatly increased after treatment of enamel with concentrated phosphoric acid solution

Bowen, 1962 used BISGMA, but it was too viscous and required dilution with other monomers

Roydhouse, 1968 used BISGMA monomer using MMA as a diluent together with peroxide amine polymerization system. He found 30% reduction of caries over a period 3 years

Buonocore, 1970 utilized same system but employed an ultraviolet sensitive polymerization initiator (benzoin methyl ether)

Requirements of the Materials used as Pit and Fissure Sealant

- Reduced water sorption and solubility
- Increased hardness and abrasion resistance after curing
- Sufficient strength, surface hardness, dimensional stability etc
- Good flow
- Suitable short setting time and adequate working time
- Same thermal conductivity as tooth
- Good bond strength with enamel
- Chemically inert, anticariogenic etc
- Low volatility
- Reduced polymerization shrinkage

The deeper parts of fissures contain organic debris and bacteria. Prophylaxis removes debris from only the surface, but does not penetrate below the visible orifice of the fissure. Although the sealant may fill deep fissures under the best conditions, bonding to the clean enamel surface is usually confined to the inclined planes of the fissure and the contents of the fissure within the body of the tooth are sealed in.



Steps in the Placement of Sealant (Figs 14.1A to G)

1. *Thorough prophylaxis*: Polished with paste free of fluoride and glycerine. Application of fluoride makes the enamel surface difficult to etch and glycerine forms an impervious coating on the surface. The tooth should be thoroughly washed to remove the pumice from the fissures.
2. *Acid etch*: Removes organic material and debris from the surface and produces micro pores into which the monomer can penetrate. Degree of etching depends on nature and concentration of acid, duration of exposure, composition and site of enamel. 30-50% orthophosphoric acid is used in liquid form for 30-60 seconds using sable hair brush. Liquid must be replenished if it flows from the surface. Etching permits the sealant to penetrate about 50 μm of enamel depth. Liquid etchant is preferred as they penetrate deep grooves better compared to the gel.
3. *Rinsing*: Tooth surface is rinsed thoroughly for 30 seconds with oil free air and water
4. *Placement of material*: Fissure sealant is applied using sable hair brush and polymerized
5. *Finish*: Feel gently with blunt explorer or small ball ended burnisher for the edges.

Materials used as Sealant

1. Cyanoacrylates:
 - Discovered in late 1950's
 - Used as surgical adhesive and tooth sealants
 - In presence of traces of moisture they polymerize rapidly to hard and brittle polymers on etched tooth surface.

Mechanical durability is not satisfactory and they are not biodegradable. Hydrolysis to potentially toxic materials occurred, as initially methyl cyanoacrylate was used. This was later replaced by butyl and isobutyl ester which was found to be more stable.

2. Polyurethanes:
 - E.g., Epoxylite (contain 10% sodium monofluoro phosphate with liquid polyurethane and utilizes citric acid as etchant),

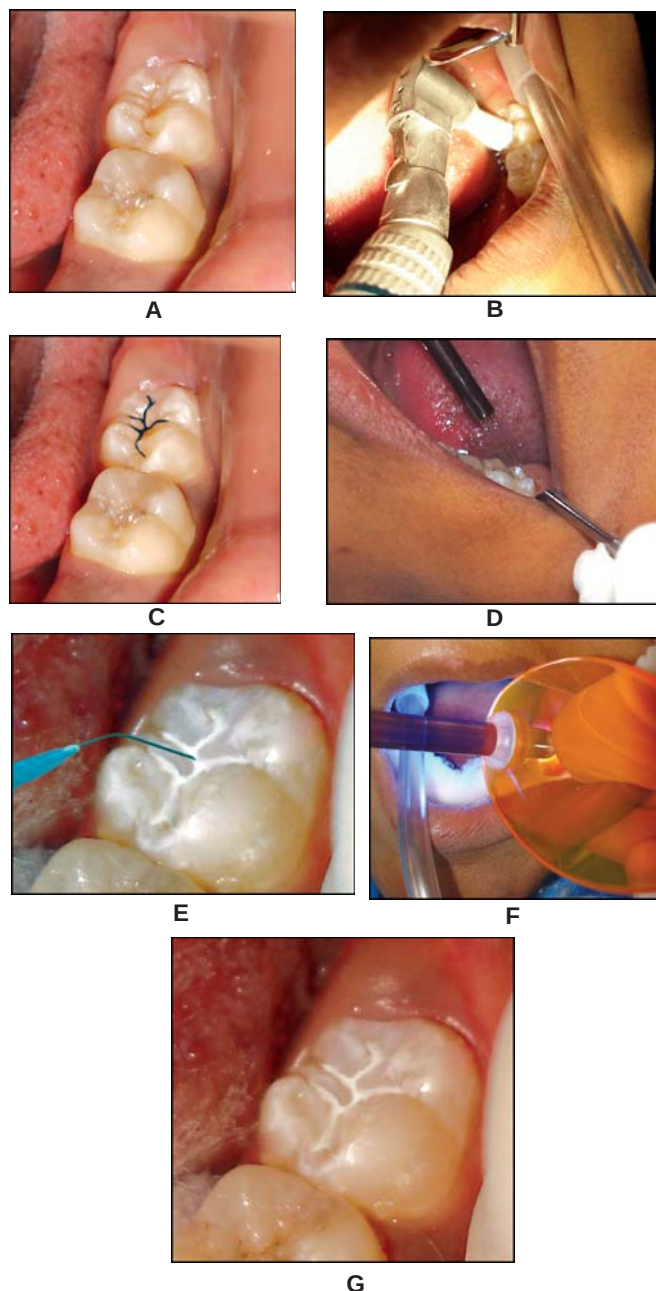


Fig. 14.1: Steps in the placement of sealant

- A: First permanent molar with deep grooves
 B: Oral prophylaxis
 C: Liquid etchant placed in the grooves
 D: Acid etch is washed with water and surface is dried
 E: Sealant is placed in the grooves with the help of the syringe. It can also be applied with a single tufted brush and varies as per the manufactures method of dispensing.
 F: Sealant is cured using visible light
 G: Sealant is finished and checked for premature contacts



- Not regularly used due to poor mechanical properties and oral durability and toxicity
- 3. Dimethacrylates:
 - MMA is highly volatile and lack penetration
 - Enamite, a new sealant utilizes MMA-PMMA system initiated by butyl boron. It binds better and is less affected by immersion in water
 - BISGMA is a viscous amber liquid of low volatility diluted with MMA (Ratio of 3: 1) for use as sealant.
- 4. Glass ionomer:
 - Developed by Mc Lean and Wilson
 - Hydrophilic, good adhesion, biocompatible, fluoride release
 - Used for fissure whose orifice exceeds 100 μm .

Classification of Resin Sealants

1. Based on Curing Method
 - First generation* – polymerized with ultraviolet light of 350 nm wavelength. Absorbed UV light excessively and prevented complete polymerization of the sealant. Light intensity varied from lamp to lamp
 - Second generation* – self cured or chemically cured. Most of them are unfilled. Can be transparent, opaque or tinted. Filled resin increased wear and abrasion resistance than unfilled resin
 - Third generation* – visible light cured of 430-490 nm wavelength. May be unfilled (usually white) or filled (usually clear)
 - Fourth generation* – with addition of fluoride for added benefit
2. Based on Presence of Filler
 - Unfilled – better flow
 - Semifilled – strong and resistant to wear
3. Based on color
 - Tinted – for easy identification
 - Clear – difficult to detect
 - Opaque – for easy identification
 - Pink (Fuji VII, G.C Company) – better fluoride release.

Properties of BISGMA

Biocompatibility

- ◆ Non irritating to tissue
- ◆ Allergic reactions must be kept in mind

- ◆ Abraded surface may promote plaque accumulation and encourage caries and staining

Ease of Manipulation

- ◆ Good results depends on manipulation characteristics like proportioning, mixing, working time, method of placement, polymerization technique and setting time. If these are not well controlled it may contribute to poor interfacial bonding and low resin strength. Curing time of self cure – 90-180 seconds and working time is 2/3 of curing time.

Viscosity and Penetration

- ◆ Usually used to fill wide shallow fissure but not narrow deep fissures, hence low viscosity is preferred. But the disadvantage is that the material flows off from the surface especially in the maxilla.
- ◆ It was found that even narrow fissures can be completely filled with a sealant having a high coefficient of penetration so long as it is applied at the proximal edge of an occlusal surface and allowed to flow to the other edge.

Dimensional Stability

- ◆ Volatility, polymerization shrinkage and thermal contraction affect the placement and stress developed which in turn influence the mechanical properties and durability of bonding.
- ◆ Extent of curing shrinkage is affected by the degree of conversion of monomer to polymer.
- ◆ Combination of thermal and polymerization shrinkage may produce high internal stresses. Cracks may develop in thin marginal layers of such sealants on hardening.
- ◆ Inhibition of polymerization by atmospheric oxygen producing an unpolymerized layer of monomer on the surface of a resin material and around the interior surface of air bubbles within the body of the material.

Physical and Mechanical Properties

- ◆ Thermal expansion and contraction as a result of hot and cold foods affect stresses generated at the interface with enamel.



- ◆ It is also affected by water absorption.
- ◆ Coefficient of thermal expansion of sealants is 7-10 times more than tooth.

Microleakage and Bacterial Survival

- ◆ Interface show minimal penetration.
- ◆ Studies have shown negligible microleakage after 6 months.
- ◆ Caries preventive effectiveness of fissure sealant is attributed to a combination of a decreased number of viable bacteria and lack of sufficient fermentable carbohydrate for the remaining bacteria to accumulate acid in cariogenic concentration.
- ◆ Also found a negative bacteriological result after 5 years in a fissure under the sealant.

Indications and Contraindications of Sealant

Surface diagnosis	Clinical consideration	Pits and fissures that are sealed	Pits and fissures that are not sealed
Carious	Occlusal anatomy	If pits and fissures are separated by transverse ridge, a sound pit or fissure may be sealed	Carious pits and fissure
Questionable	Status of proximal surface General caries activity	Sound Many occlusal lesion, few proximal lesion	Carious Many proximal lesion
Sound	Occlusal morphology Tooth age Status of proximal surface	Deep, narrow pit and fissure Recently erupted teeth Sound	Broad, well coalesced pit and fissure Teeth caries free for 4 yr Or more Caries

PREVENTIVE RESIN RESTORATIONS (PRR)

There may be deep pits and fissures present on tooth surface that require sealant therapy. In such situations if caries is present in one area or part of the pits or fissures then that particular caries is restored and remaining pits and fissures are protected with sealants. This is termed as preventive resin restoration and is thus advocated in deep pits and fissures with associated caries in initial stages (Fig. 14.2).

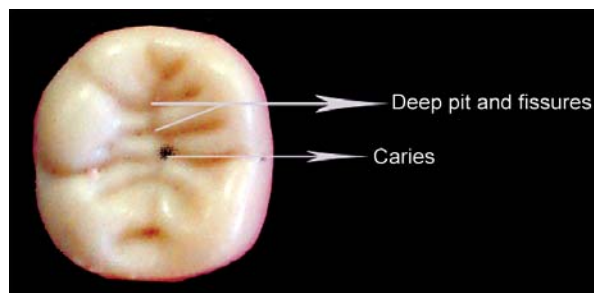


Fig. 14.2: PRR is indicated in cases where caries is present in some parts of the deep pits and fissures

Types of Preventive Resin Restoration

There are three types of preventive resin restorations based on the extent and depth of the carious lesion.

They are:

1. Type A
2. Type B
3. Type C

Armamentarium required for Preventive Resin Restorations

1. Local anesthesia (optional)
2. Rubber dam or cotton rolls
3. Cotton pellets
4. Burs: no. 114, 112 round (slow speed) no. 330 (high speed)
5. Etching gel (tooth conditioner)
6. Sealant (filled)
7. Applicator
8. Bonding agent (unfilled)
9. Calcium hydroxide liner
10. Polymerization unit (visible light)
11. Composite resin (filled)
12. Plastic (Teflon) instrument
13. Articulating paper

Type A: Preventive Resin Restoration (Fig. 14.3)

Type A comprises of suspicious pits and fissures where caries is limited to enamel. A slow-speed round bur is used to remove any decalcified enamel.

Steps involved

1. The surface is cleaned.
2. Cotton rolls or, preferably, a rubber dam is used for isolation.



3. Decalcified pits and fissures are removed with a slow speed round bur.
4. Acid etching gel is placed over the entire occlusal surface for 60 seconds.
5. It is then washed for 20 seconds and dried for 10 seconds.
6. The sealant is applied carefully, avoiding air entrapment in the preparation site.
7. It is polymerized with the visible light for 20 seconds.
8. The occlusion is adjusted, if needed, with finishing bur.

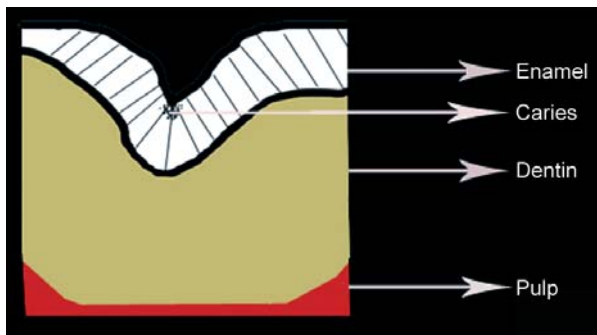


Fig. 14.3: PRR Type A—Suspicious pits and fissures where caries is limited to enamel

Type B: Preventive Resin Restoration (Fig. 14.4)

Type B comprises of incipient lesion extending into dentin that is small and confined.

Steps involved

1. Thorough prophylaxis of the surface.
2. Placement of a rubber dam.
3. Carious pits and fissures are removed with a slow speed round bur.
4. Fast setting calcium hydroxide is placed over the exposed dentin.
5. Acid etching gel is placed over the entire occlusal surface for 60 seconds.
6. It is then washed for 20 seconds and dried for 10 seconds.
7. A coat of bonding agent is applied on the walls of the preparation.
8. The preparation is then filled with composite resin material.

9. The filled sealant material is applied over the entire occlusal surface and all layers are simultaneously light cured.
10. Occlusion is adjusted and the surface is finished and polished.

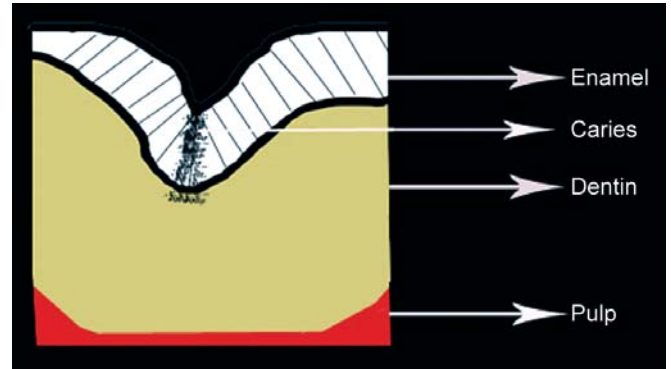


Fig. 14.4: PRR Type B - Incipient lesion extending into dentin that is small and confined

Type C: Preventive Resin Restoration (Fig. 14.5)

Type C is characterized by the presence of deep caries and need for greater exploratory preparation in dentin.

1. Thorough prophylaxis of the surface.
2. Placement of a rubber dam.
3. Carious pits and fissures are removed with a slow speed round bur. Since it involves deep caries, local anesthesia may be required.
4. A bevel is placed on the enamel cavosurface margin of the preparation.
5. Fast setting calcium hydroxide is placed over the exposed dentin.
6. Acid etching gel is placed over the entire occlusal surface for 60 seconds.
7. It is then washed for 20 seconds and dried for 10 seconds.
8. A coat of bonding agent is applied on the walls of the preparation.
9. The preparation is then filled with composite resin material.
10. The filled sealant material is applied over the entire occlusal surface and all layers are simultaneously light cured.
11. Occlusion is adjusted and the surface is finished and polished.

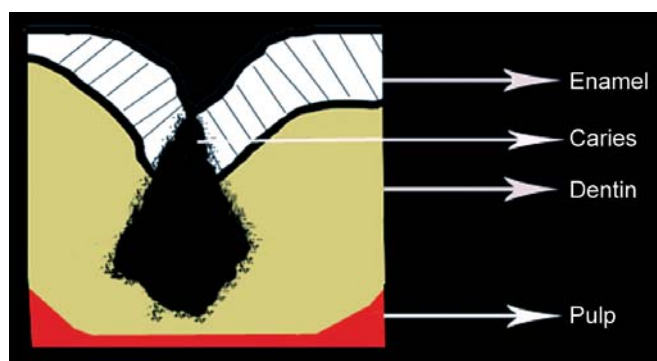


Fig. 14.5: PRR Type C - Deep caries extending deep into dentin

ATRAUMATIC RESTORATIVE TECHNIQUE (ART)

The atraumatic restorative technique (ART) is a procedure based on removing carious tooth structure using hand instruments alone and restoring the cavity with an adhesive restorative material. At present the restorative material of choice is glass-ionomer cement.

History

- Atraumatic restorative treatment was pioneered in the mid 1980s in Tanzania.
- In 1991, a community field trial started in Thailand, comparing ART with traditional treatment using dental drilling equipment and amalgam.
- Another community field trial was set up in Zimbabwe in 1993.
- The results of the study has shown that through the careful application of ART, about 85% of one-surface restorations in the permanent dentition will be in a good to acceptable condition upto about 3 years.
- The studies in Thailand and Zimbabwe, and also another community field trial, which started in 1995 in Pakistan, have clearly shown that pain is rarely experienced with this approach. In fact, if applied correctly ART is well received by the vast majority of patients.
- In conclusion, ART is quality treatment applicable to all communities.

Advantages

1. ART provides care for decayed teeth, which is non-threatening, low cost, and can prevent extractions in most cases.

2. ART is based on modern knowledge about minimal intervention techniques thereby requires minimal tooth removal.
3. Because it is a non invasive procedure, there are great potentials for its use in children as well as in fearful adults.
4. It also provides a restorative option for special groups in the community, such as the physically or mentally handicapped people living in nursing homes and the home-bound elderly.

Indication

1. Done where there is no power supply to run the motors required for cavity preparation such as in very remote villages.
2. When many people have to be treated such as in refugee camps.
3. Areas where it is difficult to take heavy equipments due to natural constraints. The equipments required for ART are few.

Contraindications

1. Presence of abscess or fistula associated with the tooth to be restored.
2. Presence of clinical pulp exposure.
3. Teeth that have been painful for a long time and may be associated with chronic inflammation of the pulp.
4. There is an obvious carious cavity but is not inaccessible to hand instruments.

Principles of Atraumatic Restorative Technique

The two main principles of ART are:

1. Removing carious tooth material using hand instruments only.
2. Restoring the cavity with a restorative material that adheres to the tooth surface.

Steps in Preparing the Cavity for Atraumatic Restorative Technique

1. Cotton rolls are placed alongside the tooth to be treated. This will absorb saliva and keep the tooth dry.
2. Plaque and other deposits are removed from the tooth surface with a wet cotton pellet, and then the surface is dried with a dry cotton pellet.



3. The extent of the caries is judged.
4. The access to the caries is widened by placing the blade of the dental hatchet into the cavity and turning the instrument forward and backward like turning a key in a lock. This movement chips off small pieces of carious enamel.
5. Carious dentin is then removed with the excavators by making circular scooping movements around the long axes of the instrument.
6. The unsupported enamel that may be present is very weak and is removed with the blade of the hatchet.
7. Restoring the cavity with glass ionomer cement using finger press technique as explained in glass ionomer section.

LEVELS OF PREVENTION, CARIES POINT OF VIEW

According to WHO (1970) levels in the prevention of caries can be mainly divided into primary, secondary and tertiary levels.

Primary Prevention Level

Primary level of prevention involves the action taken prior to the onset of disease, which removes the possibility that a disease will ever occur.

It is aimed at reducing the occurrence of new cases of disease in a population. This is accomplished by introduction of fluoride in communal water supplies or the avoidance of sucrose containing in between meal snacks. Primary level of prevention can be sub divided into sub levels, health promotion and specific protection. (The actions taken are summarized in table given below).

Secondary Prevention Level

Secondary level of prevention involves action which halts the progress of a disease at its incipient stage and prevents complications.

It aims at reducing the prevalence of caries by early diagnosis and prompt treatment. The use of radiographs to detect initial carious lesions leads to prevention at the secondary level. (The actions taken are summarized in table given below).

Tertiary Prevention Level

Tertiary level of prevention includes all measures available to reduce or limit impairment and disability, minimize suffering caused by existing departures from good health and to promote the patients adjustments to irremediable conditions. It involves a treatment phase aimed at disability limitation and rehabilitation. (The actions taken are summarized in table given below).

Levels of prevention	Primary prevention		Secondary prevention	Tertiary prevention	
Preventive services	Health promotion	Specific protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation
Services provided by the individual	Diet planning Demand for preventive services Periodic visits to dental clinic	Appropriate use of fluoride Ingestion of fluoride Use of fluoridated toothpaste Oral hygiene practises	Self examination and referral Utilization of dental services	Utilization of dental services	Utilization of dental services
Services provided by the community	Dental health education programs	Community and school water fluoridation School mouth rinse program	Periodic screening and referral Provision of dental services	Provision of dental services	Provision of dental services
Services provided by dental professional	Patient education Plaque control program Diet counseling Caries activity tests	Topical fluoride application Pit and fissure sealant	Complete examination Prompt treatment of incipient lesions Preventive resin restoration Pulp capping	Complex restoration Pulpotomy Pulpectomy Rct Extraction	Removable and fixed prosthesis Minor tooth movements Implants



HEALTH EDUCATION

It derives from a Latin word 'educare' meaning to bring out and to lead.

Dental health education is an integral part of general health education. Therefore the achievement of dental health goals will require the application of principles and processes that are effective in other aspects of health education.

The degree to which dental health education goals can be achieved is determined by a series of interrelated factors, which include:

1. The accessibility of dental health services and of advice in which individuals have confidence
2. The economic feasibility of putting into practice the dental health measure advocated.
3. The acceptability of the proposed dental health practices in terms of the customs, traditions, and beliefs of individual families and groups
4. The extent to which people already have the kinds of learning experience needed to enable them to understand or to desire the benefits that arise from new or modified dental health behaviour and such behaviour may often require a considerable personal sacrifice of a financial, social or psychological nature.

Definition

Health education is defined "as a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles, advocates environmental changes as needed to facilitate this goal and conducts professional training and research to the same end".

Objectives of Health Education

1. Informing people
 - Regarding scientific knowledge about prevention of disease and promotion of health
 - This will melt away the barriers of ignorance, prejudice and misconceptions people have about health and disease.
2. Motivating people
 - Simply telling the truth is not sufficient
 - They must be motivated to change their lifestyle accordingly

3. Guiding them into action

- Helping people to use judiciously and wisely the health services available to them
- Health education acts as the cement to bind together the brick of health program

Approaches To Public Health

1. Regulatory
 - Health promotion, achieved through the law enforcement
 - Less likely to change the habit on a long run
 - Requires vast administrative machinery
2. Service
 - Aims at providing all the needed health facilities
 - When 'felt needs' were not established they were a failure
3. Educational
 - It involves motivation, communication and decision making
 - Slow but permanent results can be obtained

Steps in the Adoption of New Ideas and Practices

1. Unawareness: Person lacks the knowledge
2. Awareness: Comes to know about the disease and its prevention
3. Interest: Seeks more detailed information
4. Evaluation: Weighs the pros and cons
5. Trial: Decision is put into practice
6. Adoption: Decides the new practice is good and adopts it.

Communication in Health Education

The purpose of communication is to transmit information from one person to another with a view to bring about behavioural changes.

Key Element in Communication

1. Communicator: the person who educates
2. Message : the knowledge or information
3. Audience: people to be educated
4. Channel for communication or aides used for communication : it can be auditory aids (tape



recorder, microphone, etc.), visual aids (not requiring projection such as chalk board, posters etc or those requiring projection like slides, movie, etc.) or combined.

Considerable information about the individual, his family background, social and cultural values, belief, perceptions, and aspirations should be done first. One of the main drawbacks in many dental health education programs has been the failure to make adequate educational diagnosis before prescribing program activities.

SCHOOL DENTAL HEALTH PROGRAM

Objectives of School Dental Service

The objectives according to the American Dental Association are:

1. To help every school child appreciate the importance of a healthy mouth.
2. To help every school child appreciate the relationship of dental health to general health and appearance.
3. To encourage the observances of dental health practices, including personal care, professional care, proper diet, and oral habits.
4. To enlist the aid of all groups and agencies interested in the promotion of school health.
5. To correlate dental health activities with the total school health activities
6. To stimulate the development of resources to-make dental care available to all children
7. To stimulate dentists to perform adequate health services for children.

Advantages of a School-based Program

1. The children of different age groups are available for preventive or treatment procedures.
2. School atmosphere is less threatening than private offices.
3. Collective education can also be provided along with individual treatment.
4. The dental service supplements the nursing services by helping to provide total healthcare for school children.

Disadvantages of a School-based Program

1. Performing dental treatment in a school is difficult due to certain limitations such as insufficient dental chairs etc.
2. Short school hours and long vacations may hinder the program.

Elements of School-based Programs

1. Improving school – community relations
2. Conducting dental inspections
3. Conducting health education
4. Performing specific programs
 - Tooth brushing program
 - Mouth rinse program
 - Fluoride tablet program
 - School water fluoridation
 - Sealant placements
5. Referral to dental care
6. Follow-up of dental inspection

ORAL HYGIENE AIDS

Types of oral hygiene aids that are used to maintain oral hygiene are:

1. Tooth brush
2. Dentifrices/Tooth paste
3. Dental floss
4. Oral rinses
5. Disclosing agents

Tooth Brushes

The overall objectives of toothbrushing are to remove plaque and food debris as well as to atraumatically stimulate gingival tissues.

History of development of tooth brushes

Crude forms of tooth brushes existed many centuries B.C. and the habit of freshening the mouth after eating may have begun with the use of tasty twigs as tooth picks. The first tooth brush was twigs or roots whose ends were chewed or hammered into fibrous brushes.



Modern day brushes first appeared in China at about 1600AD and their introduction to western world occurred in 18th century. They were made of natural bristles, fitted into bone or ivory. The natural bristles were actually hair from hogs. It was first discovered in Chungking valley, China. They contain small scale like structures seen when magnified, which help in plaque removal. It was seldom prescribed for children. It had many disadvantages such as it cannot be end rounded, expensive, hard and sharp and may cause cervical abrasion.

First nylon brushes were introduced in 1930's. They were stiff with sharp cut ends. Later these were modified into round ended bristles.

4. Serrated: Tufts are of different height alternately giving a serrated appearance (Fig. 14.8D)

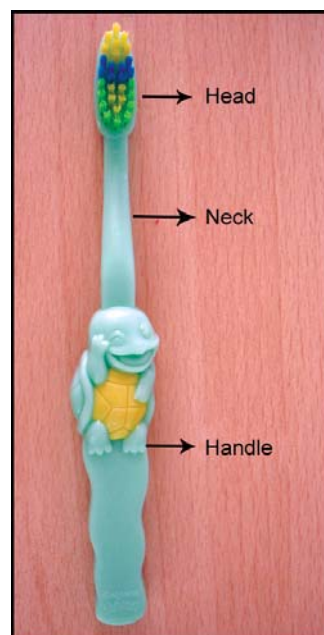


Fig. 14.6: Components of a tooth brush

Components of a Brush (Fig. 14.6)

A tooth brush consists of head and a handle connected by a neck. The head portion contains bristles, made of nylon.

Head

Correct head size of a brush should be selected for attaining maximum maneuverability in the oral cavity. The length of the head should not be >1" for adults and 1" for children. The width should be 1/2" for adults and 5/16" for children such that it is sufficient enough to cover 3 adjacent teeth.

Bristles (Fig. 14.7)

Texture of the bristles are characterized by

1. Diameter of the filament
2. Length of the exposed bristle
3. Size of the hole into which the filaments comprising a tuft are inserted
4. Number of tufts in a given area
5. Number of bristle filament in each tufts

Arrangement of the tufts, and their basic designs

1. Straight: All the tufts are of same height (Fig. 14.8A)
2. Curved or Concave: Tufts at the sides are longer and they gradually reduce in height towards the center giving a curved down or concave shape (Fig. 14.8B)
3. Convex: Tufts at the center are longer and they gradually reduce in height towards the center giving a curved up or convex shape (Fig. 14.8C)

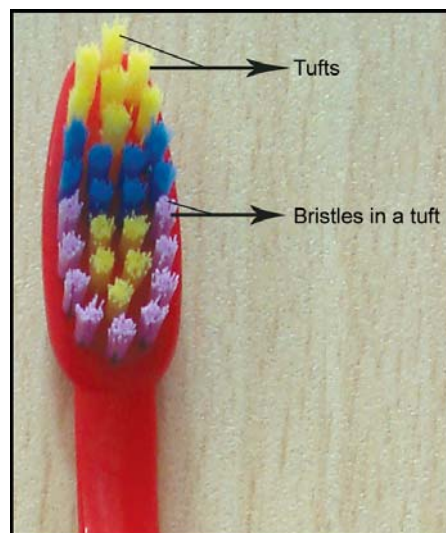
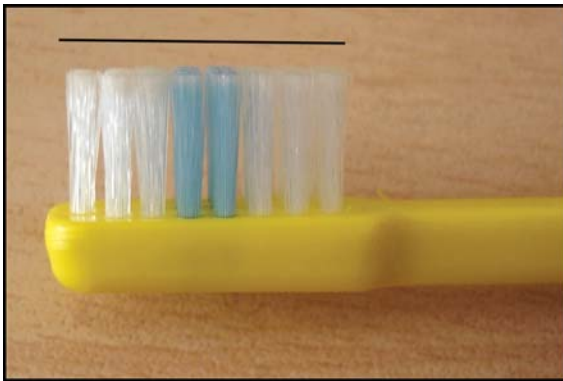


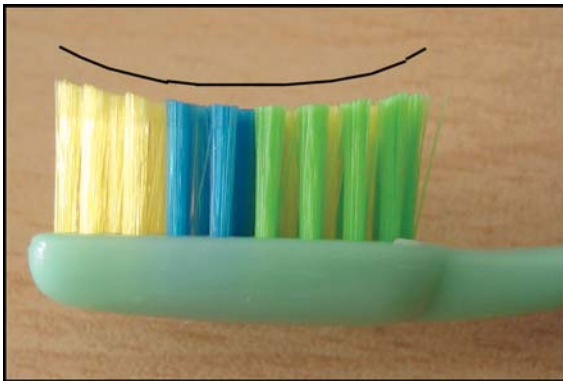
Fig. 14.7: Bristles are grouped to form tufts

Nylon bristles loose upto 27% of its stiffness when saturated with water

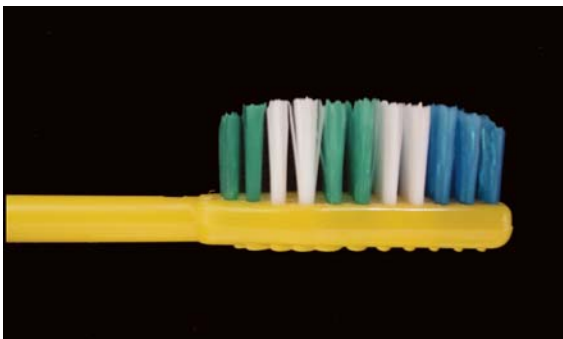
Diameter of the bristle denoting the brush type:
 Soft brush- 0.007",
 Extrasoft brush- 0.006"
 Med- 0.008"
 Extrahard- 0.0012"



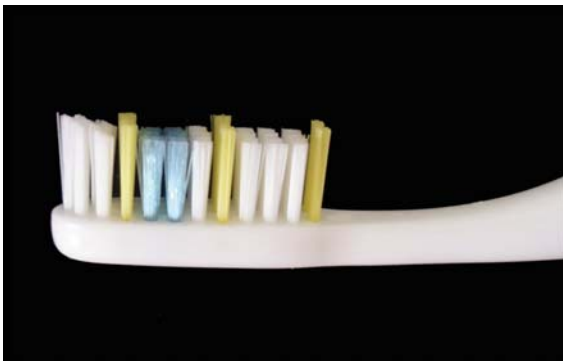
A



B



C



D

Figs 14.8A to D: Different types of arrangement of tufts;
A: Straight; B: Concave; C: Convex; D: Serrated

Ideal Pedodontic Brush

- Diameter of each nylon filament – 0.007" – 0.008"
- Tufts - 24-33
- Long handle
- Small head size

Serated bristles—According to Bass (1948) the long bristles prevented cleansing by the shorter bristles and suggested that straight trimmed bristles would fan out and reach the interproximal areas most effectively.

Modifications in Brushes

1. Finger brushes (Fig. 14.9) – these brushes are used when few teeth have erupted and will also help to accustom the child to normal bristle brushes.
2. Orthodontic brushes (Fig. 14.10) – It consists of outer rows of longer bristles and inner rows of shorter and stiffer bristles.
3. Special sulcular cleansing brushes – Used for periodontal pockets and is not regularly used in pediatric practise.
4. Pacemaker 45 – bristles are automatically placed at 45° angle to the tooth surface.
5. Interdental or proximal brushes (Figs 14.11A and B): It consists of a holder to which brushes of different shape and size can be fixed as per the need of the patient. Single tufted brushes can also be used to clean the interproximal areas.

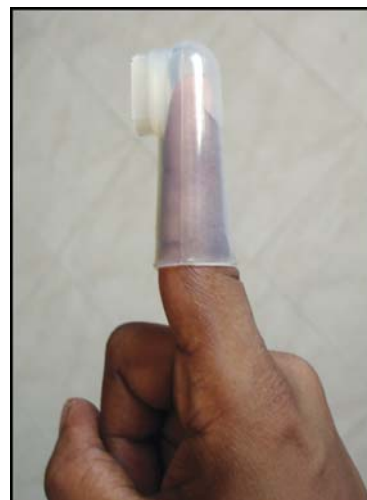


Fig. 14.9: Finger brush

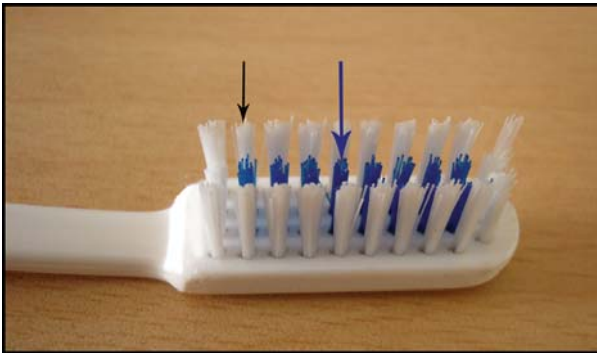


Fig. 14.10: Orthodontic brushes. Note the outer longer bristles (Black arrow) and inner shorter bristles (Blue arrow)

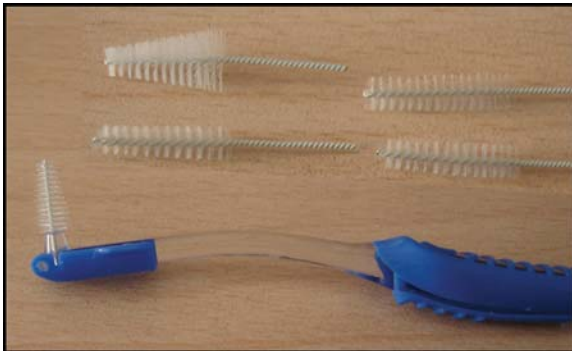
6. Travelling brushes: The brush can be folded and placed inside a box.
7. Toothette (Fig. 14.12): It consists of cotton rolled over a stick. It is used to clean the teeth or gumpads of very small children after wetting it with water. Tooth paste is not used along with toothette.



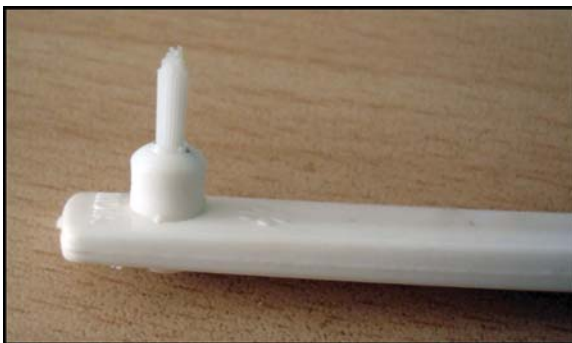
Fig. 14.12: Toothette



Fig. 14.13: Battery operated toothbrushes



A



B

Figs 14.11A and B: Interdental and proximal brushes; A: Interdental brushes of different shape with holder; B: Single tufted brush

8. Brush for the disabled children (Refer Chapter 19)– with elastic strap, bicycle handle etc
9. Electric or battery operated tooth brushes (Fig. 14.13) – It requires no manual dexterity since the bristles move by battery power. Three types of movements may be present. They are
 - i. Rotation in an arc of about 60° , so that the bristles sweep the tooth similar to roll method,
 - ii. Back to fourth horizontal action as in horizontal scrub,
 - iii. An elliptic movement combining oscillating with back and forth movements.

It is especially useful in preschool children when used by parents or children with extensive prosthetic or orthodontic appliance and in handicapped children.



TOOTH BRUSHING PROGRAM FOR CHILDREN

Techniques used are:

1. Bass/ modified Bass technique
2. Scrub technique
3. Modified Stillman technique
4. Charter's method
5. Roll technique
6. Physiologic method
7. Fones technique

Bass/Modified Bass Technique (Fig. 14.14)

The brush is placed at 45 degrees angle to the long axis of the teeth and the bristles are gently forced into the gingival sulcus and the interproximal area. It is then moved in short back and forth strokes with a vibratory action for 1 to 15 seconds for each area. The occlusal surfaces are brushed with anteroposterior short strokes. In a modified bass method, after the vibratory motion is applied, the brush is rolled towards the occlusal surface.

Modified Stillman Technique (Fig. 14.15)

The bristles are placed at 45 degrees to the apices of the teeth on the gingival margin so that they rest partly on the gingiva. The brush is then moved mesiodistally with a gradual movement towards the occlusal plane. This cleans the interproximal area and vigorously massages the gingival tissues.

Charter's Method (Fig. 14.16)

The brush is placed at 45 degrees to the long axis of the teeth. The bristles are firmly forced into the interproximal areas with a slight rotary and vibratory movement. The bristles are pressed against the sides of the teeth an gingiva and moved with short circular or back and forth strokes. This method is recommended when there is any gingival wound or injury.

Roll Technique (Fig. 14.17)

The bristles are placed high on the attached gingiva apically at a 45 degree angle. The sides of the bristles are firmly rolled against the gingiva in a coronal direction to blanch the tissues momentarily and the brush is rubbed against



Fig. 14.14: Position of the brush for Bass technique



Fig. 14.15: Position of the brush for Stillman technique



Fig. 14.16: Position of the brush for Charter method

the tooth surface in occlusal direction. It can easily be performed and is used by many people. It is more appropriate when the patient is in normal health.

Scrub Technique (Fig. 14.18)

It is the most commonly used technique. The bristles are placed at 90 degrees to the tooth surface and the brush is moved back and forth as in scrubbing a floor.



Fig. 14.17: Position of the brush for Roll technique

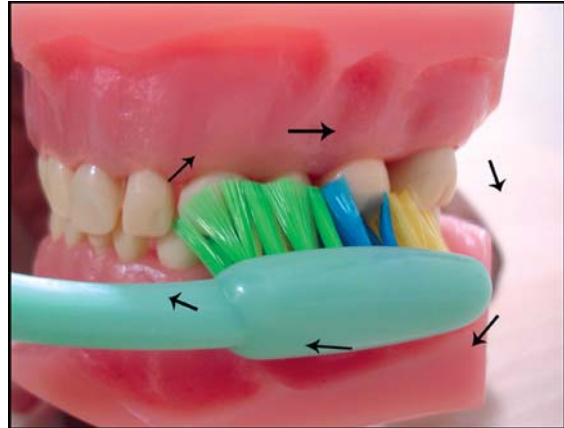


Fig. 14.20: Position of the brush for Fone's technique

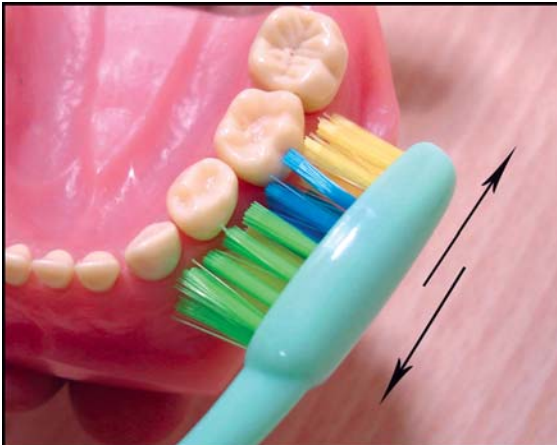


Fig. 14.18: Position of the brush for scrub technique



Fig. 14.19: Position of the brush for physiologic method

It just cleans the surface and is not a very good technique to remove plaque from the interproximal areas. This technique may also result in tooth abrasion and gingival

recession. Since this method does not require extensive techniques it is ideal for use in children.

Physiologic Method (Fig. 14.19)

This method is based on the belief that the action of brushing the teeth should simulate the passage of food over the crown towards the gingiva. It requires a soft brush and the brushing is done by sweeping from a coronal portion apically towards the gingival margin and the gingiva.

Fone's Technique (Fig. 14.20)

The brush is firmly pressed against the teeth and gingiva with the bristles at right angles to the buccal surfaces and the handle parallel with the occlusal plane. The patient occludes the teeth and the brush is moved in a rotary action with as large a radius as possible. This technique is effective for young children with minimal manual dexterity.

Recommended Brushing Techniques for Children

- Most children find horizontal scrub technique easier to perform.
- Scrub or circular scrub are best for young children with little manual dexterity and it is more effective than roll technique.
- Incisal and occlusal areas and facial and lingual two thirds are frequently not brushed. So these areas should be double checked by parents (Figs 14.21A to E).



A



B



C



D



E

Figs 14.21A to E: All the areas of the tooth should be adequately brushed. This should be demonstrated to the patient.

- A. Buccal surface of posterior teeth
- B. Lingual or palatal surface of posterior teeth
- C. Occlusal surface of posterior teeth
- D. Labial surface of anterior teeth
- E. Lingual or palatal surface of anterior teeth



- Soft to medium brushes are more efficient
- Time taken is at least 2½ to 3 minutes to cover the entire surface
- Removing plaque thoroughly once every day is sufficient to maintain healthy gingiva, thoroughness of brushing is important than frequency
- Parents brush their children's teeth until the later have achieved manual dexterity i.e., 5-6 years of age.

Guidelines for Home Oral Hygiene

Prenatal Counseling

The best time to begin counseling actually starts before the birth of the child. This is because expectant couples, particularly if the child is their first are most receptive to preventive health recommendations. They have to be counseled regarding their own oral hygiene habits and the role they shall play as models to their children.

Infant (0 to 1 year old) (Fig. 14.22)

The child should be cradled with one arm while the gum pads are massaged with the other hand. This position will provide a sense of security to the child.

The gum pads are cleaned with damp cloth or gauze. As teeth erupt small soft bristled tooth brush is used and there is no need of using any kind of paste.



Fig. 14.22: The child is cradled on the left arm and right hand is used for cleaning the gum pads

Toddler (1 to 3 years old) (Fig. 14.23)

Routine brushing is done by the parent. Plane tooth brush and water is used while brushing.

Positioning of the child and parent is important. Three positions can be used.

1. This position requires two persons. They sit on a chair facing each other, their knees touching each other. The child lies with head towards the person who will be brushing and legs towards the other adult. This position requires two people and may not be possible always (Fig. 14.23A).
2. This position also requires single person. He/she sits on the floor with his or her legs stretched out and the child is made to lie on the leg. The child's leg can be locked in between his/her leg. Left hand is used to retract the cheek and the right hand is used to brush (Fig. 14.23B).
3. This position requires single person. He/she sits on the floor with his or her legs stretched out in front and the child is positioned on the lap. The Child's head is supported by the parent's left hand or the child's head can be rested against the mother's body (Fig. 14.23C).

Preschooler (3 to 6 years old) (Fig. 14.24)

The parent stands behind the child and both face the same direction. The child rests his or her head back into the parent's left arm and right hand is used for brushing. This hand can be used also to retract the cheek, while the other hand is used to brush. This is also appropriate for flossing.

Fluoride tooth paste can be used that is pea sized if the child has learned to expectorate. It is also during this stage that fluoride gels and rinses for home use may be introduced in small quantities and limited to those patients demonstrating a moderate to high risk of caries. The use of other chemotherapeutic plaque control agents is generally not recommended.

Parents must continue to take the responsibility of the child's oral hygiene.

School Age (6 to 12 years old)

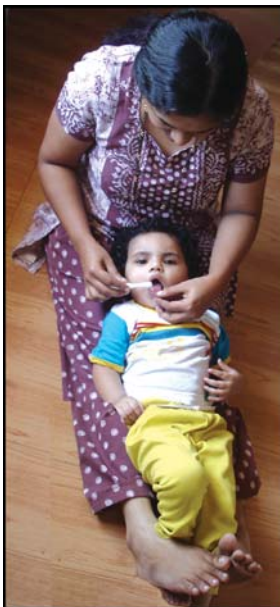
This stage is marked by acceptance of increasing responsibilities by the children. Parental involvement is still needed. However, instead of performing the oral hygiene, they can switch to active supervision. By the



A



B



C

Fig. 14.23: Positions used for brushing the teeth of a toddler
A. Requiring two persons facing each other
B. Single person and child in a sitting position
C. Single person and child in a sleeping position

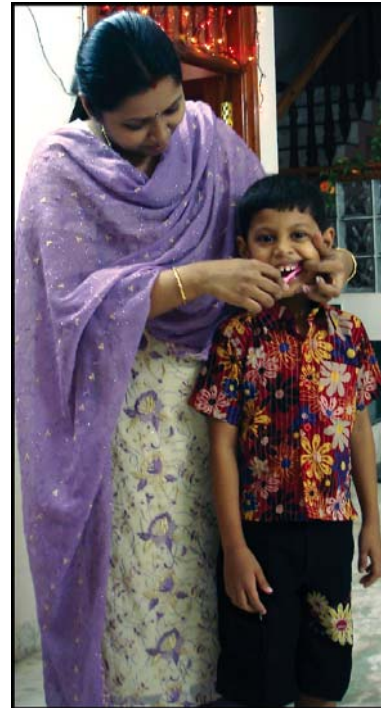


Fig. 14.24: Brushing position for a preschooler

second half of this stage, most children can brush and floss themselves. Parents may need to brush or floss their child's teeth in certain difficult to reach areas of the mouth or if there is a compliance problem. One useful adjunct, the disclosing agent may be beneficial at this stage. Children at this age can be motivated quickly and can be explained the importance of keeping their teeth clean and healthy.

In addition, the use of chlorhexidine or listerine can be introduced to those at risk for periodontal disease and caries.

Adolescents (12 to 19 years old)

Although the adolescent patient usually has developed the skills for adequate oral hygiene procedures, compliance is a major problem during this age period. Motivating an adolescent to assume responsibility for personal oral hygiene may be complicated by reactions of rebellion against external authority and some incapacity to appreciate long-term consequences. In addition, poor dietary habits and pubertal hormonal changes increase the adolescents' risk for caries and gingival inflammation. They should be constantly motivated.



Dentifrices

The word meaning is derived from latin, dens = tooth and fricare = to rub

The primary purpose of a dentifrice is to clean and polish the accessible surfaces of the teeth when used in conjunction with a tooth brush. It must provide maximum cleaning with minimum abrasion, prevent accumulation of stains, and retard the development of objectionable mouth odors.

Composition

Abrasives – (20-50%)

Abrasion that occurs during the use of dentifrice is a function of –

- Inherent hardness of the abrasive material
- Particle size and shape of the milled product
- Properties of the abrasive slurry like pH, viscosity, heat conductivity etc.
- Hardness of the bristle
- Stress applied during brushing
- Properties of the abraded surface

Increased wear is associated with – harder abrasive, sharper particles, low pH, injudicious brushing with hard bristles, excessive pressure.

Commonly used abrasives are-

- Silica gel
- Phosphate salts-DCP
- Insoluble sodium metaphosphate
- Calcium and magnesium carbonates
- Aluminium oxide

Abrasion = wearing off

Polish = implies the placing of successively finer scratches until a smooth clean surface is attained

Humectants – It prevent loss of water and subsequent hardening of the paste when exposed to water. Material used as humectants are glycerol, sorbitol, propylene glycol

Binders – They are hydrophilic colloids that stabilize the formulation and prevent separation of the solid and liquid phases during storage. Gum Arabic, gum karaya, gum tragacanth, alginates, Irish moss extract etc are used as binders. They disperse or swell to form a viscous material.

Surface active detergents – They lower the surface tension, penetrates and loosens surface deposits and emulsify or suspend the debris. Sodium lauryl sulphate is commonly used. It is soluble in water and functions in acid or alkali solution and do not form precipitate in hard water or saliva, provide foaming action and a pleasant sensation. Other substances used are sodium coconut monoglyceride sulfonate, sodium n-lauryl sarcosinate, poloxalene.

Flavouring agent- Principle agents are – mint, essential oils of anise, clove, eucalyptus, citrus, menthol, cinnamon and tutti-frutti. It may also contain synthetic sweetener like saccharin.

Preservatives- dichlorophene, benzoates, p-hydroxy-benzoates, formaldehyde, methyl/ethyl or propyl paraben are used as preservatives.

Other ingredients

Colouring agents – green, erythrocin, tartrazine, tin oxide

Therapeutic agents – ammonia and urea, chlorophyll, antibiotics like penicillin, bacitracin, erythromycin, chlorhexidine, hydrogen peroxide, fluoride, desensitizing agents-formaldehyde, potassium or silver nitrate, zinc chloride, sodium citrate, sodium fluoride, strontium chloride or triclosan.

Anti calculus agents – 3.3% pyrophosphate, tetrasodium pyrophosphate, disodium pyrophosphate

Nasadent – dentifrice used in space shuttle, and does not contain detergents, so does not require expectoration.

Dental Floss

Parmly first published the paper on the use of dental floss for cleansing the interproximal area of teeth.

1882- First floss was made commercially by Codman and Shurtleff

1948- Bass gave specifications for manufacturing dental floss, as follows

Material – should be of high tenacity bright nylon yarn, 2 denier/filament

Construction – twisting 5 threads of 70 denier, 34 filament yarn



Twists – 3 s' twist, steam set

Size – 350 denier

Denier (D) defined on the basis of the weight of a 500 denier floss. The denier of any yarn is its weight in a 9000 mt length. Thus 9000 mt of a 500D yarn should weigh 500 gm.

Classification of Dental Floss

According to American National Standard Committee, floss can be of 3 types:

Type I – unbounded dental floss comprised of yarn having no other additives.

Type II – bonded dental floss comprised of yarn having no additives other than binding agents or having additives that contribute only to cosmetic performance of floss, such as wax.

Type III – bonded or unbounded containing a drug additive intended to give a therapeutic prophylactic, such as fluorides.

Unwaxed floss - it is associated with ease of passing through tight interproximal areas and splaying action may tend to cover a larger area.

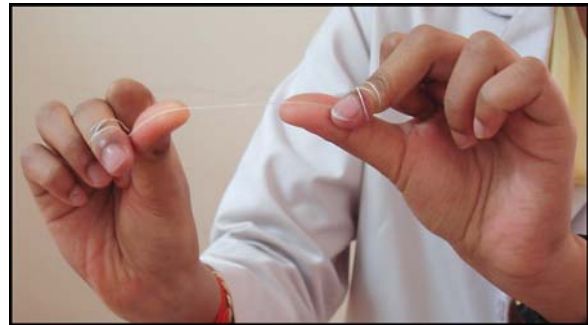
Waxed floss – commonly used in clinics for ligating rubber dam and checking interproximal contact. The problem encountered is that some wax from the floss may remain on the tooth surface and aid in plaque adhesion.

Effectiveness of Dental Floss

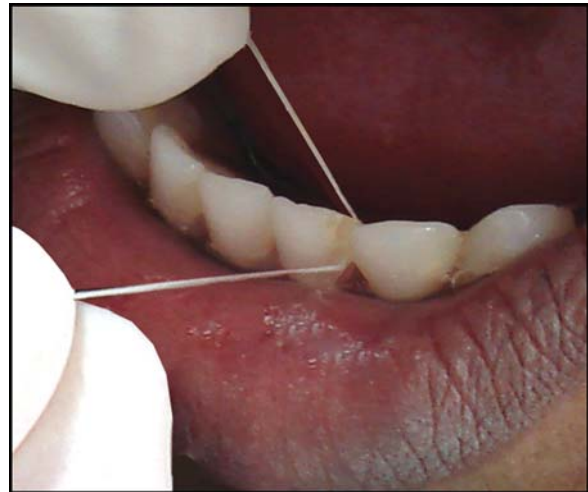
- Remove efficiently interproximal plaque and reduce plaque scores, gingival inflammation and bleeding
- Tooth brushing combined with flossing was the most efficient.

Usage of Dental Floss (Figs 14.25A and B)

It may be difficult for younger children to expertise the art of flossing or a parent might find it difficult to floss her child's teeth. This can be made easier by the use of floss holders. They are available in different shapes that enable younger children or parents to floss. Commonly used folders are 'Y' shaped (Fig. 14.26A).



A



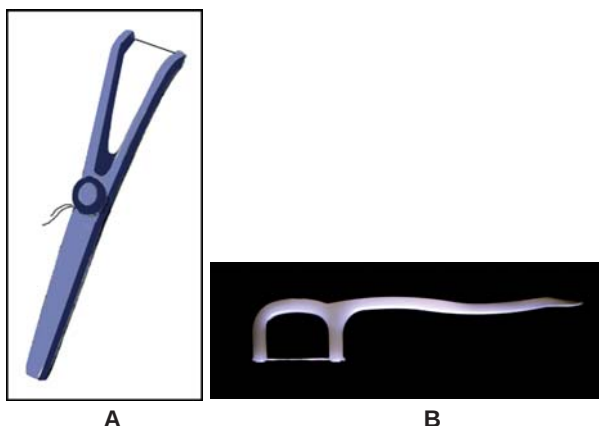
B

Figs 14.25A and B: A. Method of holding dental floss; B. Positioning of floss in between the teeth

Floss of required dimensions are cut and tied across the short arms and the remaining material is tied around the wheel that is used as reservoir. Ready made floss with holders (Fig. 14.26B) is also available. But the floss material available is limited and there is no provision for reservoir, hence the same floss has to be used for the entire mouth.

Other uses of dental floss are as follows:

1. Interproximal caries detection.
2. During fluoride application, to carry the gel or solution to the proximal areas.
3. To check the tightness of the interproximal contact.
4. To secure the rubber dam sheet in areas where application of clamp or retainer is not possible.
5. Floss can be tied to instruments such as endodontic files as safety measure for easy retrieval should the instrument slip from the operators hand.



Figs 14.26A and B: Different types of Floss holders; A: 'Y' Shaped floss holder; B: Ready made floss holder with floss attached to it

Disclosing Agents

It is difficult to visualize thin plaque in unstained vision. For efficient plaque control it becomes necessary to visualize plaque, which also helps in patient education. Disclosing agents are chemical substances that stain the plaque which makes them clear on the enamel.

Uses of Disclosing Agents

1. Estimating the patients oral hygiene status
2. In educating and motivating patient and parents regarding proper brushing habits
3. Evaluation of the patient in recall appointments
4. At homes, patients can themselves evaluate the oral hygiene procedure.

Disclosing agents can be dispensed as solutions, wafers, capsules or tablets. During routine use by the patient it is advisable to use disclosing solutions after brushing and flossing to evaluate the efficiency of their brushing.

Materials used as Disclosing Agents

The common agents used as disclosing agents are

1. Two tone
2. Erythrocin
3. Bismark brown
4. Basic fuchsin
5. Fast green
6. Mercurochrome
7. Displaque
8. Fluorescent dyes

Some agents stain the older plaque in one colour and new plaque with another. For example, two tone disclosing solution is a dye that differentiates plaque by staining older plaque in blue tones and more recent thin deposits in red or pink tones.

Fluorescent dyes are used in conjunction with a special mirror (Plak lite) with absorbency range of 200-540 nm wavelength. It utilizes tungsten light and filters or utilizes standard operatory light and optical filters or UV light. The patient examines his/her image in the mirror and the stained teeth has brilliant yellow-green color. The dye is not visible to naked eye and does not discolor the gingiva and mucosa. But the disadvantage is that of additional cost of the filters and light and also detection of plaque necessitates a darkened room.

Use of Disclosing Agent (Figs 14.27A to C)

A good disclosing agent stains the plaque deeply and may also stain pellicle faintly, but should not discolor the lips and gingiva. To avoid this, the lips, gingiva, tongue etc may be covered with layer of vaseline or the agent carefully applied only onto the tooth surface.

They are easy to use. Few drops are dropped into the mouth and swished with few drops of water or can also be swabbed directly on the tooth surface with cotton. They should not irritate the soft and hard tissues.

Summary of caries control methods and agents

Factor	Method	Agent
General	Patient education	Disclosing solution and motivation Plaque index Caries activity tests Diet diary Audiovisual materials Handouts
Susceptible tooth	Improve resistance	Fluorides Sealants
Plaque	Removal	Toothbrushing Flossing
	Inhibition	Vancomycin Chlorhexidine Vaccine
Substrate	Sugar substitution	Sorbitol Xylitol
	Diet modification	Anticariogenic foods Decrease frequency of snack, and modify the consistency of food



A



B



C

Figs 14.27A to C: Steps in disclosing plaque with two tone disclosing agent; A. Pretreatment picture, where plaque is not visible clinically; B. Disclosing agent is applied on the teeth for about one minute; C. After rinsing the mouth, Old plaque appears as blue in color and new plaque appears pink

Preventive management of caries risk patients

Risk category	Preventive options
Low	1. Dental Health Education 2. Reinforcement of good oral hygiene 3. Use of fluoride tooth paste 4. Maintained on recall visits
Moderate	1. Pit and fissure sealant 2. Dietary counseling 3. Fluoride mouthrinse 4. Professional topical fluoride 5. Use of dental floss especially when at risk for proximal caries 6. Maintained on recall visits
High	1. Preventive procedure are practiced more rigorously. 2. Recalled every 2-3 months 3. Continuous monitoring of <i>S. mutans</i> level 4. Chemical caries control

GLOBAL GOALS FOR ORAL HEALTH 2020 BY WHO

The WHO goals 'Oral Health by 2000' had stimulated awareness of the importance of oral health amongst national and local governments and acted as a catalyst for securing resources for oral health in general. Therefore, even though not all countries had achieved the goals, they provided a key focus for the effort. Recently, the FDI, WHO and IADR have embarked on the activity of preparing goals for the new millennium, for the year 2020, and these are presented here.

Aims

It aims to provide a framework for health policy makers at different levels – regional, national and local. The goals and targets are not intended to be prescriptive but believes in the phrase 'Think globally act locally'. Thus, it will provide an instrument for local and national health care planners to specify realistic goals and standards for oral health to be achieved by the year 2020.

The first step in the process is to guide health planners to evaluate the current situation of oral health and set oral health goals, objectives and targets.

Goals

1. To minimize the impact of diseases of oral and craniofacial origin on health and psychosocial



development, giving emphasis to promoting oral health and reducing oral disease amongst populations with the greatest burden of such conditions and diseases.

2. To minimize the impact of oral and craniofacial manifestations of systemic diseases on individuals and society, and to use these manifestations for early diagnosis, prevention and effective management of systemic diseases.

Objectives

1. To reduce mortality from oral and craniofacial diseases.
2. To reduce morbidity from oral and craniofacial diseases and thereby increase the quality of life.
3. To promote sustainable, priority-driven policies and programs in oral health systems that have been derived from systematic reviews of best practices (i.e. the policies are evidence-based).
4. To develop accessible cost-effective oral health systems for the prevention and control of oral and craniofacial diseases.
5. To integrate oral health promotion and care with other sectors that influence health, using the common risk factor approach.
6. To develop oral health programs that will empower people to control determinants of health.
7. To strengthen systems and methods for oral health surveillance, both processes and outcomes.
8. To promote social responsibility and ethical practices of care givers.
9. To reduce disparities in oral health between different socio-economic groups within a country and inequalities in oral health across countries.
10. To increase the number of health care providers who are trained in accurate epidemiological surveillance of oral diseases and disorders.

Targets

By the year 2020 the following will have been achieved over baseline:

Pain

- A reduction in episodes of pain of oral and craniofacial origin.
- A reduction in the number of days absent from school, employment and work resulting from pain of oral and craniofacial origin.
- A reduction in the number of people affected by functional limitations (this covers a number of measurable factors such as pain and impairments, missing teeth, traumatized incisors and congenital dental and facial anomalies).
- A reduction in the prevalence of moderate and severe social impacts on daily activities resulting from pain, impairments and aesthetics (this includes missing teeth, dental anomalies, enamel defects such as fluorosis, traumatized incisors, severe gingival recession and oral malodour).

Functional Disorders

- A reduction in the numbers of individuals experiencing difficulties in chewing, swallowing and speaking/communicating. This covers a large number of measurable factors related to tooth loss and congenital and acquired facial/dental deformities.

Infectious Diseases

- To increase the numbers of health care providers competent to recognize and minimize the risks of transmission of infectious diseases in the oral health care environment.

Oropharyngeal Cancer

- To reduce the prevalence of oro-pharyngeal cancer
- To improve the survival (5-year survival rate) of treated cases
- To increase early detection
- To increase rapid referral
- To reduce exposure to risk factors with special reference to tobacco, alcohol and improved nutrition
- To increase the number of affected individuals receiving multidisciplinary specialist care.



Oral Manifestations of HIV Infection

- To reduce the prevalence of opportunistic orofacial infections.
- To increase the number of health providers who are competent to diagnose and manage the oral manifestations of HIV infection.
- To increase the numbers of policy makers who are aware of the oral implications of HIV infection.

Noma

- To increase data on Noma from populations at risk.
- To increase early detection.
- To increase rapid referral.
- To reduce exposure to risk factors with special reference to immunization coverage or measles, improved nutrition and sanitation.
- To increase the number of affected individuals receiving multidisciplinary specialist care.

Trauma

- To increase early detection
- To increase rapid referral
- To increase the number of health care providers who are competent to diagnose and provide emergency care
- To increase the number of affected individuals receiving multidisciplinary specialist care where necessary.

Craniofacial Anomalies

- To reduce exposure to risk factors with special reference to tobacco, alcohol, teratogenic agents and improved nutrition
- To increase access to genetic screening and counseling
- To increase early detection
- To increase rapid referral
- To increase the number of affected individuals receiving multidisciplinary specialist care
- To increase early detection of seriously handicapping malocclusions and their referral.

Dental Caries

- To increase the proportion of caries free 6-year-olds
- To reduce the DMFT particularly the D component at age 12 years, with special attention to high-risk

groups within populations, utilising both distributions and means.

- To reduce the number of teeth extracted due to dental caries at ages 18, 35–44 and 65–74 years.

Developmental Anomalies of Teeth

- To reduce the prevalence of disfiguring dental fluorosis as measured by culturally sensitive measures and with special reference to the fluoride content of food, water and inappropriate supplementation.
- To reduce the prevalence of acquired developmental anomalies of teeth, with special reference to infectious diseases and inappropriate medications.
- To increase early detection for both hereditary and acquired anomalies.
- To increase referral for both hereditary and acquired anomalies.

Periodontal Diseases

- To reduce the number of teeth lost due to periodontal diseases at ages 18, 35–44 and 65–74 years with special reference to smoking, poor oral hygiene, stress and inter-current systemic diseases.
- To reduce the prevalence of necrotizing forms of periodontal diseases by reducing exposure to risk factors such as poor nutrition, stress and immunosuppression.
- To reduce the prevalence of active periodontal infection (with or without loss of attachment) in all ages.
- To increase the proportion of people in all ages with healthy periodontium (gums and supporting bone structure).

Oral Mucosal Diseases

- To increase the number of health care providers who are competent to diagnose and provide emergency care.
- To increase early detection.
- To increase rapid referral.

Salivary Gland Disorders

- To increase the numbers of health care providers who are competent to diagnose and provide emergency care.



- To increase early detection
- To increase rapid referral.

Tooth Loss

- To reduce the number of edentulous persons at ages 35–44 and 65–74 years.
- To increase the number of natural teeth present at ages 18, 35–44 and 65–74 years.
- To increase the number of individuals with functional dentitions (21 or more natural teeth) at ages 35–44 and 65–74 years.

Health Care Services

- To establish evidence-based services.

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Chapter 15



Fluorides

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INTRODUCTION

Fluoride is one of the essential agents used in preventive dentistry effective against dental caries. It has also been described as an essential nutrient in the Federal Register of United States Food and Drug Administration (1973) and also by WHO expert committee.

Fluoride is derived from a Latin word fluor, meaning to flow, since it was used as a flux. It is most electronegative with atomic weight 19 and atomic number 9.

Fluoride is found in abundance in the nature and is distributed in the lithosphere, biosphere, hydrosphere and the atmosphere.

DISTRIBUTION OF FLUORIDE IN NATURE

Fluoride in the Lithosphere

Fluoride though is considered as a trace element from the biologic point of view is present in abundance in the earth's crust and presents as 13th among them.

In the lithosphere, the fluoride is present as inorganic fluoride in:

- Siliceous igneous rocks
- Alkaline rocks
- Geothermal waters and hot springs
- Volcanic gases and fumaroles

Some of the fluoride containing minerals are

- Apatite, 34% of fluoride $\text{Ca}_5(\text{PO}_4)_3(\text{OH}, \text{F}, \text{Cl})$
- Cryolite, 54% of fluoride Na_3AlF_6
- Fluorite 49% of fluoride CaF_2

In the Biosphere

Some plants accumulate more fluoride and hence are the rich source of this mineral. The normal concentration of fluoride in leaves ranges between 2-20 ppm (parts per million). Few plants like tea plants actively accumulate fluoride and the fluoride concentrations reach several hundred ppm. The fluoride level in the soil directly influences the fluoride concentration of the plants grown in such a soil.

Concentration of fluoride tea leaves is on the average 98 ppm, leafy vegetables such as cabbages, and lettuce contain about 11-26 μg fluoride on a dry weight basis. Washing leafy vegetables reduces the intake of fluoride by about 1/2 to 1/3

In the Hydrosphere

River contains fluoride in the free form but complex fluoride increases with increasing salinity, reaching 50-60% in sea water. 47% of which are present as MgF . Sardines, salmon, mackerel and other fish contain about 20 ppm of fluoride on a dry weight basis.

In the Atmosphere

Fluoride in the atmosphere is maximum near industrial area who by product is fluoride as seen around the aluminium factory. Fluoride emissions are heaviest in the vicinity of industries involved in the production of aluminium from cryolite, phosphate fertilizers, fluorinated hydrocarbons, plastics, uranium and other heavy metals and hydrogen fluoride.

FLUORIDE IN INDIA

In India, areas with high fluoride minerals are extensive (Fig. 15.1). The main fluoride bearing areas are Gujarat, Rajasthan and Andhra Pradesh where about 70-100% of the districts are affected. Only about 10-40% districts are affected in the states of Jammu & Kashmir, Kerala, Chhatisgarh and eastern India. The remaining states have about 40-70% of the districts affected by increased fluoride in their water.

Besides these areas, fluoride is also found in some areas of Karnataka, Bihar, West Bengal, Punjab and North West Himalayas.

Whatever may be the primary source of fluorine, the element is ultimately dispersed in the environment and is found in air, atmosphere, soil and water.

Accordingly, the fluorides reach the living organisms through these elements.

ABSORPTION OF FLUORIDE

The rate and amount of fluoride absorption are determined by many factors:

- Physical form of the dose: Fluoride in the liquid form is better and quickly absorbed than in the solid form.
- Presence of food in the stomach: Fluoride absorption is slow in the presence of food.

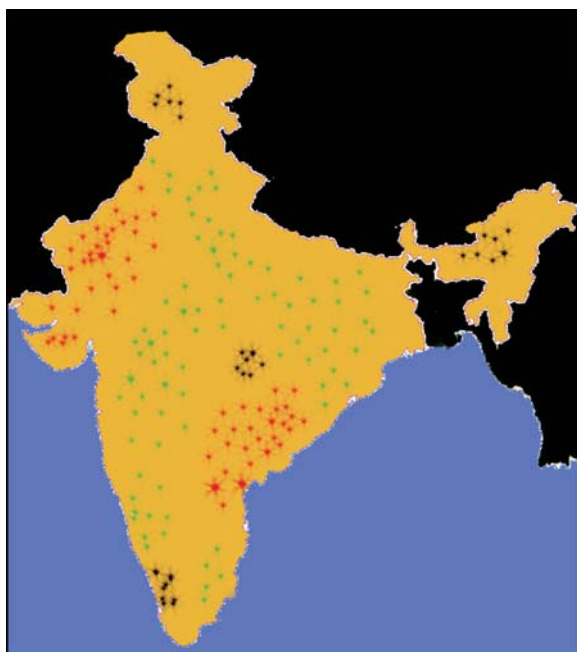


Fig. 15.1: Areas of increased fluoride distribution in India
 States having 70-100% of districts affected
 States having 40-70% of the districts affected
 States having 10-40% of the districts affected

- Composition of gastric contents: Certain items such as milk combine with fluoride and delay or prevent its absorption.
- Gastric pH: Reducing the pH enhances the fluoride absorption.
- Gastrointestinal motility: Fluoride absorption is reduced with increased motility as seen in case of diarrhea.
- Concurrent oral administration of cations like Ca, Mg, Al: They bind with fluoride thus making it unavailable for absorption.

Fluoride is absorbed from the entire gastrointestinal tract. About 80% of the dietary fluoride is absorbed and the maximum plasma concentration is reached within 60 minutes.

Fluoride is poorly absorbed with milk because

- Of formation of low soluble calcium fluoride
- Binding of F⁻ to casein and colloidal CaPO₄
- Clotting of milk due to gastric acidity, acts as physical barrier for further access of fluoride to mucosal surface of the GI tract.

DISTRIBUTION OF FLUORIDE IN THE BODY

Fluoride in Plasma

It exists in 2 general forms

1. Ionic (also called as inorganic or free fluoride)
2. Non ionic (bound fluoride)

Together they form the total plasma fluoride and are about 12 $\mu\text{m/l}$.

Fluorides in Soft Tissues

It mainly depends upon the blood flow to the tissue. The brain tissue and the adipose tissue accumulate the least amount while the kidney, heart and lungs accumulate the maximum amount of fluoride.

Fluorides in Bone

More than 95% of the fluoride in the body is retained in the bones.

Accumulation in bones depends on:

- *The fluoride intake:* Amount of fluoride accumulated is directly related to the amount of fluoride intake.
- *Type of bone:* Cancellous bone retains more fluoride than compact bone.
- *Age:* Fluoride accumulation is maximum in growing bones.
- *Duration of fluoride exposures:* Amount of fluoride accumulated is directly proportional to the duration of exposure to fluoride.

Fluorides are deposited in dental tissues in successive stages during the life of the tooth. The initial deposition occurs while the organic and mineral phases are being laid down. Next it is deposited from the tissue fluids during the preeruptive maturation phase. Finally fluoride is acquired topically during post eruptive maturation and aging period.

Amount of Fluoride in the tooth
 Outer enamel - 2,200-3,200 ppm
 Dentin - 200-300 ppm
 Cementum - 4,500 ppm
 Pulp - 100-650 ppm



EXCRETION OF FLUORIDE

Excretion through the kidneys forms the major route for the elimination of fluoride. About 30% is excreted within 3 hours and remaining 40-60% is excreted within 24 hours. Increase in urine pH increases the fluoride excretion. Remaining fluoride is excreted through the feces (10%), Breast milk (0.001-0.005 ppm), Sweat (10-25%) and saliva (0.01-0.05 ppm).

HISTORICAL EVOLUTION OF FLUORIDES AS CARIES PREVENTIVE AGENT

- 1901: Dr. Frederick McKay of Colorado, USA discovered permanent stain on the teeth of his patients which was referred to as "Colorado brown stain". McKay named the stain as mottled enamel.
- 1902: Dr. J.M. Eager, a US marine hospital surgeon, stationed in Italy reported a high proportion of Italian residents in Naples who had ugly brown stains on their teeth known as 'denti di chiaie'.
- 1916: McKay and Black examined 6873 individuals in USA and reported that an unknown causative factor of mottled enamel was possibly present in domestic water during the period of tooth calcification.
- 1930: Kemp and McKay observed that no mottling occurred in people who grew up in bauxite prior to 1909, the year in which bauxite had changed its supply from shallow wells to deep drilled wells.
- 1931: New methods of spectrographic analysis led to the identification of fluoride in the drinking water, a discovery made independently in three different places at about the same time.
Churchill H V (Bauxite)
Smith M.C, Lantz E.M, Smith H.V (Arizona)
Velu H, Balozet L (France)
- 1931: Shoe leather survey: Trendley H Dean carried out a survey in the US, which was a continuation of McKay's work, to find out the extent of geographical distribution of mottled enamel.
- 1935: Dean gave his mottling index
1ppm- no stain
2.5-3 ppm - dull chalky appearance
4 ppm - discrete pitting

1941: "21 city" study, carried out by Dean et al. The objective was to define the water fluoride levels which represented the best compromise between low caries experience and a level of fluorosis which could be considered acceptable. The first part consisted of clinical data from children 12-14 years old with life time residence in 8 suburban Chicago communities with stable mean fluoride levels. The project later added 13 additional communities in 4 other American states. This was a land mark epidemiologic survey which led to the adoption of 0.7-1 mg fl/liter of water as optimum amount of fluoride in drinking water.

1945: World's first artificial fluoridation was started at Grand Rapids, USA

1969: Fluoridation was endorsed by the WHO.

MECHANISM OF ACTION OF FLUORIDE

Hypothesis regarding fluoride anticaries mechanism of action:

1. Effect on hydroxyapatite crystals
 - a. Decreasing its solubility
 - b. Improving its crystallinity
 - c. Remineralization
2. Effect on bacteria
 - a. Inhibiting enzymes
 - b. Suppressing cariogenic flora
3. Effect on the enamel surface
 - a. Desorbing protein/bacteria
 - b. Lowering the free surface energy
4. Alteration of the tooth morphology.

Decreasing the Solubility of Hydroxyapatite Crystals

Fluoride reduces the solubility of hydroxyapatite crystals during acid attack. Two theories are used to explain this.

- i. *Void theory*: Voids are normally present in any crystal which decreases the stability and increases the chemical reactivity. In hydroxyapatite crystal, fluoride fills up these voids and makes the crystal stable, by formation of additional as well as stronger hydrogen bonds leading to lower



solubility and greater resistance to dissolution in acids.

- ii. *FAP vs HAP*: It is said that fluorapatite is less soluble than hydroxyapatite.



Improving the Crystallinity of Hydroxyapatite

Fluorides increase the crystal size and produce less strain in the crystal lattice. This takes place by conversion of amorphous calcium phosphate to crystalline hydroxy-phosphate.

Various calcium phosphate phases are:

- Dicalcium phosphate dihydrate (DCPD)
- Dicalcium phosphate anhydrate (DCP)
- Tricalcium phosphate (TCP)
- Octa calcium phosphate (OCP).

Remineralization

It is a process of deposition of apatite or like material in enamel and dentin tissues after partial loss of normal mineral.

Fluoride stimulates apatite precipitation. Frequent application of low level fluoride will effectively inhibit demineralization and enhance remineralization.

Enzyme Inhibition

Fluoride has enolase inhibition effects and inhibits glucose transport also. Enolase is a metalloenzyme that requires divalent cation for its activity (Mg^{++}). Fluoride due to its increased reactivity forms complexes with divalent cations. Thus it inhibits the metalloenzyme.

It also has shown to inhibit non metalloenzymes like phosphatases, acetylcholinesterase, etc. All the above effects are interrelated through PEP (Phospho Enol Pyruvate) phospho transferase system that is found in *S. salivarius*, *S. mutans*, *S. sanguis*. This leads to reduced acid production and reduced glucose transport into the cell.

Suppressing the Flora

Fluoride suppresses the growth of bacteria. Stannous fluoride is more potent. Stannous ion oxidizes the thiol group present in the bacteria required for its metabolism.

Desorption of Protein and Bacteria

Hydroxyapatite crystals are amphoteric with both positive and negative receptor site. Acidic protein group binds at calcium site and basic protein groups bind at phosphate site. Fluoride inhibits the binding of acidic protein to hydroxyapatite.

Lowering the Free Surface Energy

Fluoride by reducing the free surface energy prevents accumulation of plaque.

Alteration of Tooth Morphology

Dentition in fluoridated communities show a tendency towards rounded cusps, shallow fissures, wider tooth and improved alignment. All these make the tooth at less risk for development of caries.

DIFFERENT MODES OF FLUORIDE ADMINISTRATION

1. *Systemic*: In this mode fluoride is taken in a dietary form. Fluoride is absorbed into the circulation and reaches the developing teeth. Fluoride is also secreted into the saliva and gingival crevicular fluid.
2. *Topical*: They are moderate to high concentration fluoride applied topically on the tooth surface.

Systemic Fluorides

1. Water fluoridation
2. Salt fluoridation
3. Milk fluoridation
4. Fluoride tablets

Water Fluoridation

Definition

“Controlled adjustment of the concentration of fluoride in a community water supply so as to achieve a maximum caries reduction and a clinically insignificant level of fluorosis”

Important Studies

In US and Canada, studies on fluoridation of water began in 1945.



January 1945 – studies were done at Grand Rapids (Experimental city) and Muskegon (Control city).

May 1945 – studies were done at Newburgh (Experimental city) and Kingston (Control city)

1946–Studies were done at Evanston (Experimental city) and Oak Park (Control city).

The results of all these studies were as follows

- Fluoride is the etiological factor for the observed low caries levels in areas with naturally fluoridated drinking water
- There is no difference between the effect of naturally and artificially fluoridated water
- Controlled addition of fluoride to water is technically possible within narrow limits.
- When fluoridation was discontinued in a community, there was a dramatic increase in the dental caries incidence.

Caries reduction benefits to primary teeth was 40-50% and to the permanent teeth was 50-60%.

Fluoride benefit is not uniform and varies depending on tooth surfaces:

Buccal and lingual – 85%

Inter proximal – 75%

Pit and fissures – 35%

Optimum concentration of fluoride in the drinking water to produce maximum anticaries benefit and minimum toxicity.

This varies according to the climatic condition. In the tropical climates, water consumption is more than in cold climates and hence the amount of fluoride added to drinking water must be less than in cold climatic region.

A formula given by Galagan and Vermillion is used to decide the amount of fluoride that should be added to the drinking water and is as follows:

Galagan and Vermillion formula: Amount of fluoride in ppm = $0.34/E$

Where $E = -0.038 + 0.0062 \times \text{temperature in } ^\circ\text{F}$.

Recommended = 0.7 to 1.2 ppm (0.7 ppm in tropical climate and 1.2 ppm in cold climate).

Advantages of Water Fluoridation

- As people drink water daily, fluoride is consumed along with it
- Large number of people can benefit
- Cheap and effective

Disadvantages of Water Fluoridation

- Other modes of fluoride intake should be considered. There is increased risk of overdosage of fluoride in individuals consuming other fluoride supplements.
- The entire population should consume water from one source. Fluoridation is not possible in area where people drink water from their individual well or rivers.
- Every individual whether one likes it or not is forced to consume fluoridated water, thus interfering with human rights and fundamental liberties.

School Water Fluoridation

It is a suitable alternative, where community water fluoridation is not feasible. Children can benefit by drinking fluoridated water when fluoride is added to the school water tank. The amount of fluoride added to the school water is more as they spend only 20-25% of their total working hours in school. The recommended level of fluoride is 4.5 times that of the optimum level.

Disadvantages

- Children are already 5-6 years when they attend the school. Benefits of systemic fluoride are maximum during the developing stages of fluoride. Most of the tooth crowns would have already formed by then they are relatively less beneficial.
- Continued monitoring of water is required. School authorities should hire a person who is well informed regarding the risk associated with adding excess fluoride to the water. He should monitor the total activity regularly.

Different Fluoride Compounds Used for Water Fluoridation

1. Sodium fluoride was used initially and is expensive. Sodium silicofluoride is preferred alternatively due its low cost



2. Fluosilicic acid [hydrofluosilicic acid] – it is corrosive and requires careful supervision.
3. Fluorspar [calcium fluoride] – it costs 1/3 as much as sodium silicofluoride, but difficult to dissolve.
4. Ammonium fluosilicate.
5. Sodium silicofluoride.

Salt Fluoridation

Introduced in Switzerland (1955) by Wespi. Initially 90 mg fl/kg salt was used, later it was increased to 200-350 mg fl/ kg of salt. Clinical trials in Switzerland, showed 20-25% reduction of caries with 90 mg of fluoride. It was then decided that to obtain the same amount of fluoride benefit as water fluoridation, the amount in salt has to be increased to 300 mg/kg yielding 1.5 mg fl/ 5 gm of salt.

Method of Production of Fluoridated Salt

In Switzerland and Hungary fluoride is added by spraying concentrated solution of sodium fluoride or potassium fluoride to salt on a conveyer belt.

In USA sodium fluoride and calcium fluoride are first mixed with a suitable phosphate carrier salt and these premixed granules are added to the salt.

Advantage

- Individualized monitoring is not required, as the levels are adjusted to provide optimum levels of fluoride, keeping in account that a person consumes 5-8 gms of salt per day
- Everyone consumes salt, irrespective of ethnic or regional variation
- Readily acceptable, as the addition of fluoride to salt does not change the color, odour, consistency or taste.

Disadvantage

- Special plant has to be set up for fluoridation of the salt
- Consumption of fluoridated salt in areas with increased fluoride concentration in drinking water may lead to overdose.

Milk Fluoridation

It was first mentioned by Zeigler in 1956. 36.3% caries reduction was observed with 2.5 mg of sodium fluoride added to milk daily in school meals.

There was a controversy concerning the binding and complexing of fluoride with calcium and milk protein thus reducing its anti caries effect.

Erickson (1958) using radioactive isotope technique proved the availability of fluoride from milk. But the release of fluoride from milk is mild and slow compared to that from water.

Disadvantage

- Fluoride is available to only those who drink milk. In India children living in low socioeconomic areas may not drink milk daily
- In most of the rural areas there is no central milk supply, hence fluoridation is not possible.

Fluoride Tablets

It was introduced in the late 1940's intended to be used as a substitute for fluoridated water. Fluoride tablet is prescribed by a dental practitioner for individual patients keeping in account the fluoride concentration in the drinking water and other fluoride supplements consumed.

Availability

- Tablets or drops to be swallowed, chewed or sucked
- Tablets available as 0.25 mg, 0.5 mg, 1.0 mg
- Sodium fluoride, acidulated phosphate fluoride, potassium fluoride or calcium fluoride.

Dosage: It is calculated keeping in mind the water fluoride level of the community (Table 15.1). Less amount of fluoride in tablet form is recommended for children residing in areas having increased level of fluoride in drinking water. Therefore for children residing in areas where the drinking water level of fluoride is more than 0.6 ppm, fluoride supplement is not required.



Table 15.1: Amount of fluoride supplementation, based on the age and amount of fluoride in drinking water According to ADA February 1994

Fluoride concentration of drinking water (ppm)				
Age	< 0.3	> 0.3 < 0.6	>0.6	
0-6 months	-	-	-	
6 mon-3 yrs	0.25mg	-	-	
3-6 yrs	0.5 mg	0.25 mg	-	
6-16 yrs	1.00 mg	0.5 mg	-	

Topical Fluorides

1. Solution/thixotropic gels/foam
2. Dentifrice
3. Rinse
4. Varnish
5. Slow release system

Systemic fluoride has many disadvantages and the associated risks has definitely outnumbered its beneficial effects.

Efficient methods of fluoride therapy at the individual level surfaced in 1941, when the first clinical study of NaF was carried out by Bibby.

Topically applied fluorides are deposited onto the surface of the tooth and they tend to provide local protection at or near the tooth surface. Plaque, saliva and oral mucosa also serves as a reservoir for fluoride ions. During a cariogenic challenge, fluoride from these sources is mobilized to assist remineralization.

Topical fluorides can be used at home or applied by professional in the clinics. Topical fluorides advocated for home use contain comparatively less amount of fluoride and are used daily or regularly. Professionally applied fluoride agents contain very high amount of fluoride and are applied less frequently, majority being biannually.

Solution/Thixotropic Gels/Foam

They may be in the form of sodium fluoride, stannous fluoride or APF. Thixotropic gels are better than solution due their high viscosity and inherent property to flow under pressure. They contain methyl cellulose that is responsible for their viscosity. Use of foam reduces the risk of overdosage.

Sodium Fluoride

- 2% NaF is used
- neutral pH
- 9,200 ppm of available fluoride
- 29% effective in caries reduction
- milestone studies were done by Bibby and Knutson in 1941, 1942, 1947, 1948, using varied fluoride concentration and number of appointments.

Knutson's Technique

It is the technique recommended by Knutson for the application of 2% neutral sodium fluoride.

It consists of 4 applications at weekly intervals in a year at age group of 3, 7, 11, and 13 years. This age group was selected depending on the eruption of deciduous dentition, first permanent molar and incisors, premolar and canines and second molars respectively.

Oral prophylaxis was done on the first day of each series. The teeth were isolated and dried. The solution is applied on the teeth with cotton applicators or trays can be used for gels. Once applied the solution is allowed to dry on the tooth without reapplication for 4 minutes.

The patient is asked not to swallow the gel or solution but should be expectorated, and not to eat or drink for 30 min and not to eat for the next 1 hour.

Disadvantage of Knutson's technique:

- patient has to make 4 visits within short time
- interval of upto 4 years between series may be too long for maximal cariostatic protection

Method of preparation of 1 litre of neutral NaF: 20 gm of NaF is dissolved in 1 litre of distilled water. It is stored in plastic bottles as fluoride reacts with silica of glass to form SiF_2 , reducing the available fluoride.

Mechanism of action: When sodium fluoride is applied on the tooth surface there is rapid influx of fluoride leading to the formation of calcium fluoride. The calcium fluoride forms a layer on the tooth surface blocking further entry of fluoride ions. This sudden stop of the entry of fluoride is termed as "Chocking off effect". Fluoride then slowly leaches from the calcium fluoride. Thus calcium fluoride acts as a reservoir for fluoride



release and that is the reason why sodium fluoride is kept untouched on the tooth for 4 minutes.

Stannous Fluoride

- 8% SnF_2 is used
- 2.4-2.8 pH
- 19,500 ppm of available fluoride and 32% effective in caries reduction
- Dudding and Muhler in 1962 described the use of stannous fluoride and 8-10% was tested and found to be effective.

Method of preparation: It has to be freshly prepared as it is unstable. The stannous ion gets oxidised to stannic ion which is not effective. 0.8 gms of SnF_2 is dissolved in 10 ml of water to obtain 8% SnF_2 .

Application (Muhler's technique)

- Annual application
- Thorough prophylaxis and isolation is followed by quadrant wise application.
- Applied continuously for 4 minutes. Reapplication is done every 15-30 seconds.

Mechanism of action: SnF_2 reacts with hydroxyapatite with the formation of 4 products

1. Stannous trifluorophosphate (main product)
2. Stannous hydroxy phosphate (formed in low concentrations of SnF_2 and is responsible for the metallic after taste)
3. Calcium trifluorostannate (formed in high concentrations of SnF_2)
4. Calcium fluoride

Disadvantages

- Undergoes rapid oxidation and is unstable
- Should be freshly prepared
- Taste is disagreeable
- Gingival tissue irritation
- Staining of teeth.

Acidulated Phosphate Fluoride (APF)

- 1.23% is used
- 12,300 ppm of available fluoride

- 3.0 pH
- 28% effective in caries reduction
- 1963- Brudevold and coworkers did a study to find optimum acid concentration to provide maximal fluoride deposition and minimal demineralization and also found adding phosphate provided maximum benefit.

Preparation of 1.23% APF: 20 gms of NaF is dissolved in 1 litre of 0.1M phosphoric acid. To this 50% hydrofluoric acid is added to adjust the pH to 3.0 and fluoride concentration to 1.23%.

Application (Brudevold's technique):

- Prophylaxis and isolation is done first. Fluoride is applied with cotton applicators and kept wet for 4 minutes.
- Biannual application

Mechanism of action: Initially it leads to dehydration and shrinkage in volume of hydroxyapatite crystals and formation of dicalcium phosphate dehydrate (DCPD). The DCPD formed is highly reactive with fluoride, leading to formation of fluorapatite (FAP). The amount and depth of fluoride deposited as FAP depends on the amount and depth at which DCPD gets formed. Since for the conversion of whole of DCPD formed into FAP, continuous supply of fluoride is required, APF has to be applied every 30 seconds and the teeth are kept wet for 4 minutes.

Disadvantages

- Acidic
- When stored in glass container, etches the glass
- Prolonged exposure to composite or porcelain, results in loss of surface material and unaesthetic appearance.

Characteristics	Sodium fluoride	Stannous fluoride	APF
Percentage	2%	8%	1.23%
ppm of fluoride	9,200	19,500	12,300
pH	Neutral	2.4-2.8	3.0
Frequency of application	4 at weekly interval at 3,7,11 & 13 years	Biannually	Biannually
Tooth pigmentation	No	Yes	No
Gingival irritation	No	Yes	No
Caries reduction	29%	32%	28%



Fluoride Gel

- Easier to work
- Permits application in trays – entire dentition can be treated at one time
- NaF and APF gels – contain the same concentration of fluoride and pH as their respective aqueous solutions.
- Gels contain – cellulose compound for viscosity
- Thixotropic gels – gels that flow under pressure penetrate better interproximally and do not drip.

Fluoride Foam

- pH is 6.0
- It is marketed only in some countries
- Much lighter and requires application of little amount of the material
- Risk of over dosage is reduced

Others

Ammonium fluoride, titanium fluoride, amine fluoride – hold fluoride in contact with tooth surfaces for longer periods. Used in toothpaste, rinses and gels and is under study.

Professional application of fluoride (Figs 15.2A to C)

1. Patient and the parents should be explained regarding the benefits and risks of topical fluorides
2. Patient is made to sit upright on the dental chair so that the saliva and excess fluoride is not accidentally swallowed
3. Saliva ejector is held in place to remove excess fluoride and saliva
4. Trays are filled to $\frac{1}{3}$ to $\frac{1}{2}$ its height. The tray is then placed in the mouth and the flanges are pressed against the tooth surface.
5. Excess fluoride is removed with saliva ejector
6. Lower arch is done first followed by the upper. If upper is done first the saliva that has been pooled in the floor of the mouth will make it difficult to place the lower tray.
7. The trays are placed in contact with the tooth for 4 minutes. It is then removed and discarded. Fluoride on the tooth surface is removed by saliva ejector or asking the patient to spit the excess.

8. Patient is not allowed to wash his mouth. Rubbing with cotton is avoided for removal of excess fluoride from the tooth surface.
9. Instruction are given to the patient which includes-
 - Not to drink any liquid food for at least half an hour
 - Not to eat any solid food for one hour at least
 - To report immediately if any symptoms of acute toxicity is noticed.



A



B



C

Figs 15.2A to C: Steps in the application of fluoride; A: Trays used for fluoride application; B: The trays are loaded with fluoride; C: The tray is kept in the mouth for 4 minutes, with saliva ejector in place to remove excess material and saliva



Methods of Increasing the Fluoride Uptake by the Enamel

1. Increasing the time of contact of fluoride with the enamel
2. Pretreating the enamel with 0.05M phosphoric acid
3. Addition of casein phosphate to fluoride preparation.

Fluoride Dentifrices

It is a simplest and rational way of combating caries. It combines the mechanical effect of tooth brushing with fluoride benefit. It was first introduced by Bibby in 1945 and Muhler in 1955.

Amount of Fluoride Present in the Dentifrice

Ideally 1000ppm of fluoride should be present but dentifrices containing less or more than 1000 ppm of fluoride are also available. 2-3 year old children usually ingest majority of the dentifrice during brushing. Hence dentifrice containing less amount of fluoride should be prescribed to a preschooler.

Fluoride toothpaste that contain 1000 ppm fluoride, contain 500-600 ppm of free fluoride in 50 gm of tooth paste. Therefore a 200 gm tube of tooth paste contains 140 mg of free fluoride

Sodium fluoride and sodium monofluorophosphate are preferred as fluoride agents, due to their compatibility with abrasives and absence of brown staining and metallic taste unlike stannous fluoride.

Abrasive Compatibility

Basic problem with fluoride dentifrice is the incompatibility of the fluoride agent (Sodium fluoride) with calcium containing abrasives. These abrasives combine with fluoride to form calcium fluoride thus reducing the freely available fluoride making it inactive. This has been overcome by the introduction of monofluorophosphate.

Abrasives that are compatible with monofluorophosphate and sodium fluoride are:

- Calcium pyrophosphate
- Hydrated silica
- Sodium bicarbonate

- Acrylic polymer
- Insoluble sodium metaphosphate

Abrasives that are compatible with Monofluorophosphate are:

- Alumina trihydrate
- Anhydrous dicalcium phosphate
- Dicalcium phosphate dihydrate
- Calcium carbonate

Recommendation for Fluoride Toothpaste

<4 years: Fluoride toothpaste is not recommended. Dentifrice containing less fluoride may be given depending individual case.

4-6 years: Once with fluoride tooth paste, twice without paste

6-10 years: Twice with fluoride tooth paste, once without paste

>10 years: Thrice with fluoride toothpaste.

Fluoride Rinses

- Sodium fluoride and acidulated phosphate fluoride are used as rinse
- 50% reduction in caries was seen when 0.2% and 0.05% Sodium fluoride was used. 23% caries reduction was observed with acidulated phosphate fluoride
- Most frequently used is sodium fluoride rinse - 0.2% for fortnightly rinse (909 ppm) and 0.05% for daily rinse (227 ppm)
- **Method of rinsing:** 10 ml of the solution is swished vigorously for 1 minute and expectorated.
- **Large scale or home method of rinse preparation:** 200 mg NaF tablet + 5 tsp fresh clean water (25 ml) to yield 25 ml of NaF rinse.
- Commercially available rinse of 200 mg NaF contains – 10 mg of sodium fluoride + lactose (filler).

School Rinse Programs

- Children in large group are made to stand in a line. Each are given a small cup with the measured amount of rinse. They are asked to put the solution into the mouth and swish it for one minute. Then all of them are told to expectorate the solution.



Children in a school can be grouped based on their class and fortnightly rinse is effective.

Advantage of school-based rinse programs

- Safe and effective
- Relatively inexpensive
- Easy to learn and do
- Non dental personnel can supervise
- Well accepted by participants
- Less time is required - 5 minutes

Disadvantage of school-based rinse programs

- School teaching hours are compromised
- Teachers and parents should be educated and motivated regarding the benefits
- During long school vacations rinse program cannot be done
 - Mouth rinsing is not recommended for preschool children and less amount (5 ml) is to be used for kindergarten children
 - 10 ml of 0.05% NaF - contains 2.3 mg fluoride.
 - Weekly fluoride rinse program have become standard for organized school based programs in U.S.A
 - In India, fluoride rinse program on a large scale has not been implemented.

Fluoride Varnishes

Fluoride varnish was first developed in Europe (1964) by Schimdt. The main advantage of varnish is that it increases the time the fluoride is in contact with the tooth.

Indications

- Handicapped children
- Incipient caries lesion
- After restorative treatment is complete under general anesthesia
- Very young children who cannot expectorate the gel or foam

Commonly used Fluoride Varnishes are

1. Duraphat
2. Fluorprotector
3. Carex

Duraphat

- 2.26% sodium fluoride in organic lacquer

- 22,600 ppm fluoride
- Hardens into a yellowish brown coating in the presence of saliva

Fluorprotector

- 0.7% difluorosilane in polyurethane lacquer
- 7,000 ppm of fluoride

Carex

- contains lower fluoride concentration than duraphat (1.8%) but anticaries effect is equivalent to duraphat.

Fluorprotector contains low fluoride, but the fluoride deposited in enamel is twice more than duraphat but has low caries inhibition. This is due to :
 $\text{Silane fluoride} + \text{water} = \text{Hydrofluoric acid} = \text{fluoride penetrates readily and forms tags } 0.5\text{-}1.0 \mu\text{m long, leading to increased fluoride concentration. But this prevents further fluoride penetration thus reducing the anticaries effect.}$

Steps involved in the application of varnish:

- Prophylaxis
- Isolation required is very minimum. It is sufficient to just remove the thick mucous coat on the tooth surface. Isolation is not done with cotton as it tends to stick to the varnish and presence of mild moisture tends to hasten the setting of the varnish.
- Varnish is applied with single tufted small brush (Fig. 15.3)



Fig. 15.3: Fluoride varnish is applied using single tufted brush



- Application done first on lower arch
- After application, the patient is asked to keep the mouth open till the varnish dries
- Patient is instructed not to rinse or drink for 1 hour.

Topical fluoride can be used routinely for any child. But some of the definite indications are:

- Caries active individuals
- Children shortly after periods of tooth eruption
- Individuals who are on salivary flow reducing medications
- Individuals with disease that decrease salivary flow
- Patients after periodontal surgery, when roots are exposed
- Individuals with eating disorder
- Mentally and physically challenged individuals.

RECENT ADVANCES IN FLUORIDE RESEARCH

Fluoride is the most effective preventive agent in dentistry and attempts have been made to utilize it in a variety of ways to reap systemic and topical benefits in the prevention of dental caries. The recent advances in fluoride research are:

1. Iontophoresis
2. Fluoride-chlorhexidine preparations
3. Fluoride containing dental cements
4. Fluoride containing amalgam
5. Fluoride containing alginates
6. Fluoride impregnated dental floss
7. Fluoride chewing gum

Iontophoresis

Iontophoresis has been used in dentistry for the past 80 years. It is based on the theory that a small electric current will help drive fluoride ions further into dental enamel, producing the desired effect. Iontophoresis has been used most frequently to treat hypersensitive teeth, usually in conjunction with a topical fluoride agent. Consequently, it is difficult to prove conclusively that iontophoresis significantly helps penetration of fluoride into the enamel.

Fluoride—Chlorhexidine Preparations

Chlorhexidine is a powerful inhibitor of gingivitis and plaque formation and has been used with fluoride to prevent gingivitis and dental caries. They are compatible with each other.

Fluoride Containing Dental Cements

Certain dental restorative materials increase the solubility of enamel. The solubility property of these materials was reduced when fluoride was incorporated in to them.

When stannous fluoride was incorporated into the liquid of zinc phosphate cement, it was found that enamel became less soluble, however the reductions diminished over time. Sodium monofluorophosphate was successfully incorporated into zinc oxide eugenol cement.

The matrix of glass ionomer cement consists of sheathed droplets of calcium fluoride. The slow leaching of fluoride from this matrix would impart anticaries action similar to that of silicate cement.

Fluoride Containing Amalgam

Addition of 1.5% stannous fluoride to silver amalgam alloy showed a significant reduction in enamel acid solubility. The concentration of stannous fluoride in the finished silver amalgam restoration was 0.75 to 18%.

Fluoride Containing Alginates

Addition of 1.9% fluoride to alginate produced salivary concentration of fluoride of approximately 111 ppm.

Fluoride Impregnated Dental Floss

Unwaxed dental floss was impregnated with a saturated solution of APF and it was found that flossing with the fluoride-impregnated floss significantly increased fluoride uptake compared to flossing with conventional floss.

Fluoride Chewing Gum

Chewing gum has been used as a vehicle for delivery of fluoride. The mean fluoride concentration in whole saliva following ingestion of fluoride chewing gum was shown to be markedly increased. Chewing gum may



be a satisfactory method of delivering fluoride to enamel surfaces, but the clinical cariostatic effects need further documentation.

FLUORIDE TOXICITY

Toxicity is due to excessive ingestion of fluoride and can be acute or chronic. Acute toxicity is due to ingestion of large dose of fluoride in a short period of time while chronic toxicity is due to ingestion of excess fluoride in low doses over a prolonged period of time.

Acute Fluoride Toxicity

Safely tolerated dose is 8 - 16 mg / kg body weight. When fluoride is consumed beyond this limit it can lead to symptoms of toxicity.

Lethal dose of fluoride is 32 - 64 mg / kg body weight. When fluoride is consumed beyond this limit it can lead to death.

Factors Influencing Acute Toxicity

- *Form of administration:* Fluoride administered in liquid form is absorbed quickly, hence the symptoms of toxicity is rapidly seen.
- *Age:* Younger the age more severe and faster are the symptoms of toxicity.
- *Rate of absorption:* Rate of absorption depends on many factors already discussed initially in this chapter.

Signs and Symptoms of Acute Fluoride Toxicity

- Nausea, vomiting, abdominal pain, increased salivation, nasal discharge
- Generalized weakness, carpopedal spasm
- Reduced plasma calcium level, increased plasma potassium level
- Weak thready pulse, fall in blood pressure
- Depression of respiratory centre
- Cardiac arrhythmia
- Coma and death

Management of acute toxicity

Immediate management should be aimed at:

- Reducing the fluoride absorption by inducing vomiting through emetics
- Increasing fluoride excretion by increasing the alkalinity of the urine and fluid replacement
- Plasma calcium and potassium level monitoring

Management based on the amount of fluoride ions ingested

< 5.0 mg/kg	Milk Induce vomiting
>5.0 mg/kg	Induce vomiting Milk, 5% calcium gluconate, Hospitalization
> 15.0 mg/kg	Induce vomiting Cardiac monitoring - peaking of T wave and prolonged QT interval in a ECG Slow administration of 10 ml of 10% calcium gluconate Maintain adequate urine output Supportive measures for shock

Possible Ways to Reduce the Intake of Excess Fluorides especially at home:

1. Parental supervision
2. Small amount of tooth paste to be used
3. Products with low fluoride level to be used
4. Teaching children not to swallow paste or rinse
5. Strict adherence to professional advice

Molecular conversion ratio

$\text{NaF} = 1/2.2$

$\text{SnF}_2 = 1/4.1$

$\text{Na}_2\text{PO}_3 = 1/7.6$

Calculations of the percentage of fluoride ion in the total amount of fluoride agent swallowed:

- Multiply the percentage of the fluoride agent with the molecular conversion ratio of that particular fluoride agent to obtain the percentage of fluoride ions present

Example: for 2% sodium fluoride

$$2 \times 1/2.2 = 0.9\% \text{ fluoride ions}$$

- To convert the percentage of fluoride ion to fluoride mg/gm, multiply the percentage of fluoride ions with 10

$$0.9 \times 10 = 9 \text{ mg of fluoride ions in one gram of sodium fluoride}$$

- To calculate the amount of fluoride ions swallowed, multiply the fluoride in mg/gms with the total amount of agent swallowed. This gives the total amount of fluoride ions present in the amount swallowed



- 9 mg/ gm $\times$ total amount of sodium fluoride swallowed = total amount of fluoride ions swallowed
- From this the toxic dose of fluoride can be calculated for a given child based on the body weight as total amount of fluoride ions swallowed / weight of the child in kgs.

Chronic Toxicity

It is caused due to ingestion of excess amount of fluoride over a prolonged period of time. It can cause dental and skeletal changes referred to as dental and skeletal fluorosis respectively.

Dental Fluorosis

Direct inhibitory effect on enzymatic action of ameloblasts by fluoride leads to defective matrix formation and subsequent hypomineralization in case of fluorosis.

Mild changes are seen when water fluoride level increases to more than 3 ppm

Severe changes are seen when water fluoride level increases to more than 4-8 ppm

Management of Dental Fluorosis

Dental fluorosis may range from mild to severe changes. The changes include discoloration, surface roughness, pitting or surface erosion. Treatment includes bleaching, composite restoration, veneers or complete crown restorations.

Daily dose of >0.07 mg F/Kg body weight/day for children with developing teeth may result in fluorosis

Index Used For Measuring Fluorosis

1. Dean's index
2. Thylstrup and Fejerskov scoring
3. Horowitz index

1. Dean's Index

Score Criteria

- | | |
|-----|--|
| 0 | Normal |
| 0.5 | Questionable with few flecks to occasional white spots |

- | | |
|---|---|
| 1 | Very mild, small, opaque, paper white areas scattered irregularly, involving $< 25\%$ |
| 2 | Mild, involving $< 50\%$ |
| 3 | Moderate - all the surfaces are involved with attrition and brown stain |
| 4 | Severe - discrete or confluent pitting and corroded appearance |

2. Thylstrup and Fejerskov Scoring

Score Criteria

- | | |
|---|--|
| 0 | Normal translucency of enamel after prolonged drying |
| 1 | Narrow wide lines, corresponding to the perikymata |
| 2 | More pronounced lines, occasionally confluent |
| 3 | Merging and irregular cloudy areas |
| 4 | Entire surface is chalky white |
| 5 | Entire surface is opaque with pits that are < 2 mm in diameter |
| 6 | Regularly arranged pits forming horizontal bands with < 2 mm vertical extension |
| 7 | Loss of outer most enamel with irregular surface not covering more than $\frac{1}{2}$ of the surface |
| 8 | Loss of outer most enamel covering more than $\frac{1}{2}$ the surface |
| 9 | Loss of main part of enamel with change in anatomic appearance of the tooth |

3. Horowitz Index

Score Criteria

- | | |
|---|--|
| 0 | no evidence of fluorosis |
| 1 | snow capped tooth with areas of white extending upto the $\frac{1}{3}$ of the incisal edge and cusp tips |
| 2 | extending more than $\frac{1}{3}$ but less than $\frac{2}{3}$ |
| 3 | extending more than $\frac{2}{3}$ |
| 4 | stains and any of the above |
| 5 | discrete pitting without stain |
| 6 | discrete pitting with stain |
| 7 | confluent pitting and loss of enamel |



Difference between fluorosis and hypoplasia

Characteristics	Fluorosis	Hypoplasia
Area affected	Entire surface	Centered, smooth, Limited extent.
Lesion shape	Follow incremental Lines	Round or oval
Demarcation, Color	Diffuse, Opaque white/brownish white	Clearly differentiated Opaque white, cream yellow, to dark reddish
Teeth affected	Homologous teeth Early erupting teeth are least affected. Premolar and second molar are severely affected	Common on the labial surface of single or homologous teeth. Any teeth can be affected

DEFLUORIDATION OF WATER

The states having high fluoride levels (endemic fluoride belts with fluoride content in water more than 4.00 ppm) are

- Punjab
- Haryana
- Rajasthan
- Gujarat
- Madhya Pradesh
- Andhra Pradesh
- Tamilnadu
- Delhi

Several methods that have been implemented to defluoridate the community water are as follows. These may be divided into two basic types:

- I. Based upon cation exchange process or adsorption,
- II. Based upon addition of chemicals to water during treatment.

Cation Exchange Method

- A. *Defluoron 1*: A sulphonated saw dust impregnated with 2% alum solution is used.
- B. *Carbion*: It is a cation exchange resin of good durability and can be used on sodium and hydrogen cycles.
- C. *Magnesia*: It removes the excess fluoride but pH of treated water was beyond 10 and its correction by acidification or recarbonation was necessary.

D. *Defluoron 2* : This was developed in 1968. It is a sulphonated coal and works on the aluminum cycles.

Nalgonda Technique of Defluoridation

The Nalgonda technique involves addition in sequence of sodium aluminate or lime, bleaching powder and filter alum to the fluoride water followed by flocculation, sedimentation and filtration. The technique is extremely useful both for domestic as well as for community water supplies.

Mechanism of Defluoridation by Nalgonda Technique

Rapid mix: Rapid mixing is an operation by which the coagulant is rapidly and uniformly dispersed through the single or multiple phase system. This helps in the formation of microflocs and results in proper utilization of chemical coagulant, preventing localization of concentration and premature formation of hydroxides which leads to less utilization of coagulants.

Flocculation: Flocculation is the second stage in the formation of settleable particles [FLOCS] from destabilized colloidal sized particles and is achieved by gentle and prolonged mixing.

Sedimentation: It is the separation from the water by gravitational setting of suspended particles that are heavier than water.

Filtration: This is the final step. The water is allowed to stand for about half an hour and the water collected at the top is utilized for drinking.

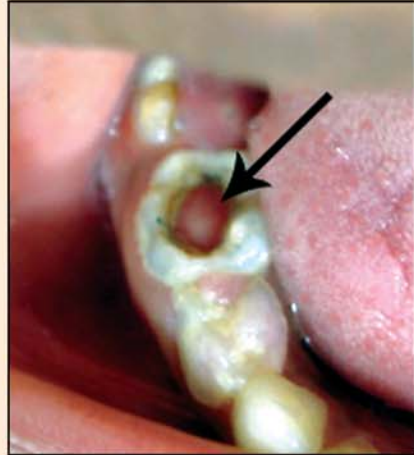
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Chapter 16



Pulp Therapy

1. Introduction
2. Classification of Pulpal Diseases
3. Classification of Periradicular Diseases
4. Diagnosis of Pulp Pathology
5. Individual Tooth Assessment and Pulp Therapy
 - Indirect pulp capping
 - Direct pulp capping
 - Pulpotomy
 - Pulpectomy
 - Apexification
 - Apexogenesis



INTRODUCTION

Management of young pulp is a very challenging task, which is attributed to the difference between the deciduous and permanent pulp. These changes are summarized below:

THE DIFFERENCE BETWEEN PRIMARY AND PERMANENT PULP (FIG. 16.1)

- Pulp chamber in a deciduous teeth is larger compared to the crown size
- The roots are thin and slender with narrow pulp canals
- Mesial pulp horns extend closer towards outer surface. This increases the risk of pulp exposure during cavity preparation.
- Accessory canals extend from pulpal chamber to the interradicular area at the furcation. Therefore the radiographic changes (radiolucency that is caused due to widening of periodontal space and resorption of bone) is seen in the interradicular region rather than the periapical region.
- Deciduous pulp is highly vascularized. Thus it exhibits typical inflammatory response to any irritating stimulus, and is at high-risk for internal and external resorption. Localization of infection and inflammation is very poor for the same reason.
- Increased rate of reparative dentin formation is seen in deciduous teeth
- The nerve fibers are few in number thus exhibiting reduced sensitivity to pain
- Root canals are ribbon shaped or have a hour glass appearance. The canals are narrower mesiodistally, which makes gross enlargement of the canal
- Multiple ramifications are common in deciduous pulp canal making complete debridement difficult if not impossible.

CLASSIFICATION OF PULPAL DISEASES

Etiology of pulpal disease may range from physical (Cavity preparation without the use of coolants, trauma to the tooth, thermal or electrical irritation), chemical (Irritants such as acids, monomer etc on pulp directly

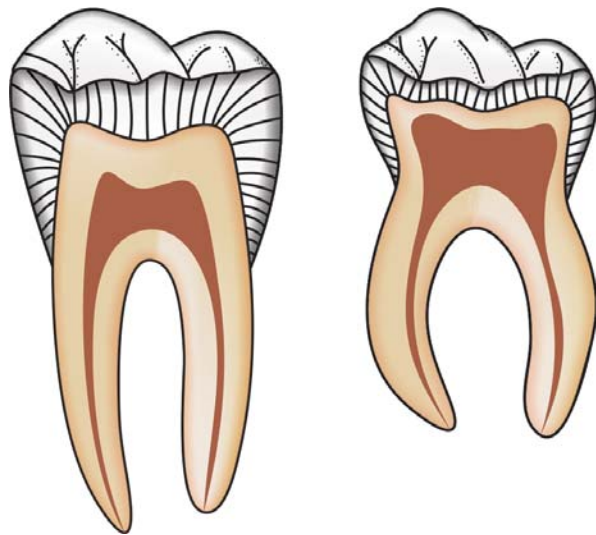


Fig. 16.1: Longitudinal section of permanent and deciduous molars

or through thin dentin) or bacterial (Direct bacterial attack, toxins produced by the bacteria or may be anachoretic effect) insults.

Based on the extent of pulpal damage, disease of the pulp can be classified as-

1. Pulpitis i. Reversible - Symptomatic (Acute)
 - Asymptomatic (Chronic)ii. Irreversible- Acute
 - Chronic - Asymptomatic with exposure
 - Hyperplastic pulpitis
 - Internal resorption
2. Pulp degeneration-calcific and others (seen in elderly people)
3. Necrosis

Reversible Pulpitis

Definition

“Mild to moderate inflammatory condition of the pulp caused by noxious stimuli, in which the pulp is capable of returning to the uninfamed state following removal of the stimuli”.

Clinical Features

- Reversible pulpitis may be due to direct or indirect injury to the pulp. A pulp may be irritated through



the exposed thin dentin, resulting in inflammatory reaction within the pulp. Injury to the pulp can also be due to lack of adequate insulation below a restoration.

- Pain that is associated with reversible pulpitis is transient in nature, lasting for a moment and subsides soon after removal of the stimuli.

Treatment

- A good restoration with adequate and effective insulation.

Irreversible Pulpitis

Definition

“Persistent inflammatory condition of the pulp, which is symptomatic or asymptomatic caused by a noxious stimulus”.

Clinical Features

Pain that is associated with irreversible pulpitis is sharp, piercing or shooting type. It is continuous in nature that lasts for several minutes to hours after removal of the stimuli. Pain may also be aggravated by sudden changes in temperature, pressure or on lying down.

Treatment

- Pulpectomy or root canal therapy.

Chronic Hyperplastic Pulpitis (Pulp polyp)

Clinical Features

- Characterized by the development of granulation tissue, covered by epithelium, that protrudes as a polyp out of the pulpal chamber (Fig. 16.2)
- Occurs in tooth with extensive carious exposure of the pulp, associated with long standing, low grade irritation.
- Usually asymptomatic but pain may be present during mastication

Treatment

Pulpectomy or extraction

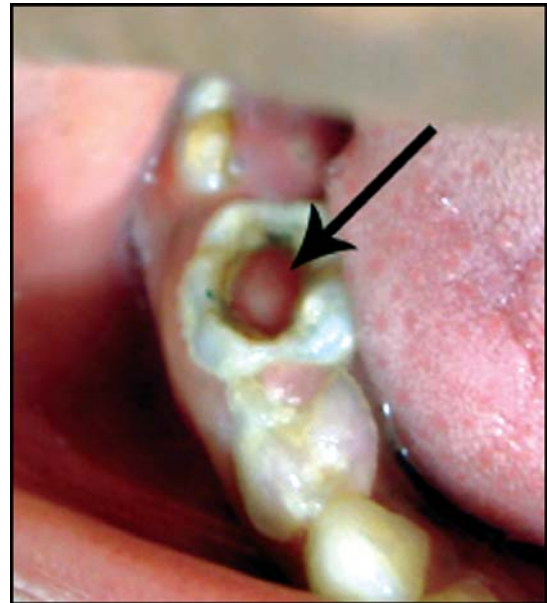


Fig. 16.2: Pulp polyp in the lower right second deciduous tooth

Internal Resorption

Definition

“Idiopathic slow or fast progressive resorptive process occurring in the dentin of the pulp chamber or pulp canal of the teeth”.

Clinical Features

- Initially it is asymptomatic.
- Internal resorption may occur in pulp chamber or pulp canal.
- Crown may appear pink called as pink tooth when the internal resorption is present in the coronal portion. Radiographically no gross changes are seen except for widening of the pulpal chamber and thinning of the dentin.
- Internal resorption involving the root canal appears as round to oval radiolucent area that extends from the pulp canal.
- Internal resorption may proceed if left untreated to perforate the entire dentin thickness and communicate with the periodontal space. Prognosis becomes very poor when the tooth is associated with extensive resorption.

**Treatment**

- Pulp extirpation and routine endodontic procedure, if the resorption is mild to moderate. The process of resorption ceases after removal of the pulp.
- When the resorption is very extensive and prognosis is poor it is advisable to extract the involved tooth.

Necrosis of the Pulp

It is associated with the death of the pulp, and the tooth is termed as being non vital.

Clinical Features

- The involved tooth may be asymptomatic or associated with pain.
- It may also be associated with periapical abscess draining either intra orally or extra orally.
- The crown of the tooth may be discolored.

Treatment

- Pulpectomy or root canal therapy is the choice when the clinical crown is restorable.
- If the clinical crown is grossly destroyed due to caries, the treatment of choice is extraction following by suitable rehabilitation.

CLASSIFICATION OF PERIRADICULAR DISEASES

1. Acute
 - Acute apical periodontitis
 - Acute alveolar abscess
 - Phoenix abscess
2. Chronic
 - Chronic alveolar abscess
 - Granuloma
 - Radicular cyst
 - Condensing osteitis
 - External resorption

Acute and chronic abscess are very common in children.

Acute Alveolar Abscess**Definition**

“Localized collection of pus in the alveolar bone at the root apex of the tooth, with extension of the infection through the apical foramen into the periradicular tissue”.

Pulp in such a condition is necrotic most of the time.

Clinical Features

Initially the tooth that is affected is tender with soft tissue swelling. As it progresses, the swelling becomes more pronounced and the tooth becomes mobile and elevated from the socket. If left untreated, it may lead to osteitis, cellulitis and osteomyelitis. It can be also associated with slight rise in body temperature, chills, malaise and headache.

Radiographic changes are minimum – as the changes are confined to medullary bone only.

Treatment

- Establishment of drainage. An incision is given at the area where the abscess ‘points’. Followed by root canal therapy or pulpectomy.

Chronic Abscess

It is seen in tooth associated with long standing, low grade infection of the periradicular tissues. It is most of the time associated with discharging sinus or fistula. Patients usually have no complaints except may be for occasional pain.

DIAGNOSIS OF PULP PATHOLOGY

The success of the treatment used depends mainly upon an accurate preoperative assessment of pulp status. Complete case history, examination and investigation forms the pre-requisite for correct diagnosis.

Diagnostic Features**Pain**

An accurate history must be obtained of the type of pain, including its duration, frequency, location and spread as well as aggravating and relieving factors.

The absence of toothache does not preclude a histologic pulpitis. The active lives of children, together with their short attention spans, may mean that minor discomfort passes without comment in a whirlwind of activities.



A positive history of toothache suggests definite pulp pathology. However it is difficult to correlate the type of pain with the degree of pathosis.

Sensitivity to thermal stimuli — indicates vital pulp.

Momentary pain — may be due to exposure of dentin from a leaking restoration or an open lesion and the pathosis is confined to coronal pulp.

Persistent pain — indicates widespread inflammation of the pulp, extending throughout the radicular filaments.

Pain may be radiated to other teeth, jaw, temple or sinuses. It then becomes difficult to identify the involved tooth.

Pain on percussion indicates that supporting periodontal fibers are inflamed. Depression of the tooth results in pain. The tooth may be slightly elevated from the socket and in premature occlusion. This increases the discomfort, especially during mastication.

Swelling

It may be present intraorally or extraorally.

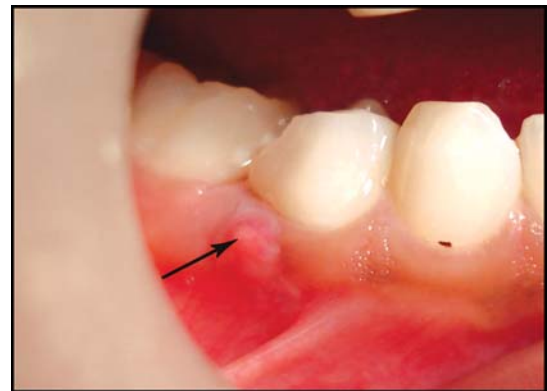
Intraoral swelling (Fig. 16.3):

It is usually apparent on the buccal aspect of the alveolus. There is less bone on the buccal aspect than on the lingual or palatal side, through which the inflammatory products from the periapical or inter radicular regions penetrate, taking the path of least resistance. The pressure of the swelling will eventually result in spontaneous drainage if treatment is not rendered.

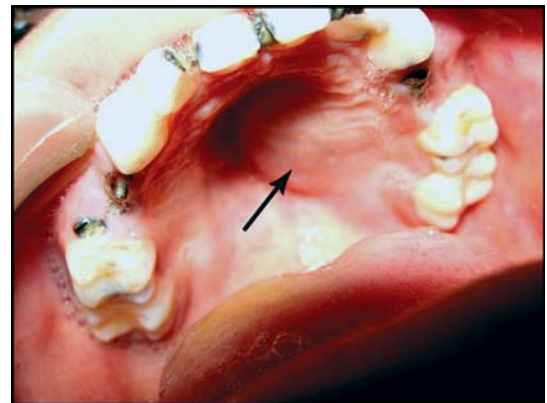
The fine apical foramen precludes the drainage of the exudate through the open lesion and drainage occurs through the formation of fistula, usually seen at the junction of the attached gingiva and alveolar mucosa, corresponding to the site adjacent to the interraderic region.

The tissue adjacent to the fistula is inflamed. Once the fistula is formed, drainage is established and lesion is seldom acute and becomes a chronic lesion.

Extraoral swelling-/cellulites (Fig. 16.4): It is due to the spread of exudate into various spaces along the fascial planes. In the mandibular arch, submandibular region is commonly involved and in the maxillary arch, the swelling may extend upto the infraorbital margin, may



A



B

Figs 16.3A and B: A. Intraoral swelling on the buccal aspect; B. Intraoral swelling on the palatal aspect

involve the upper eye lid or may be so severe as to close the child's eye. The drainage occurs through the path of least resistance, which is through the skin.

A tooth associated with swelling or fistula is usually nonvital. Sometimes one of the canals may contain inflamed but vital pulp. From the treatment point of view the tooth is considered nonvital.

Discoloration

Tooth that is nonvital tend to have a darker color (Fig. 16.5). Tooth associated with internal resorption at the pulp chamber tend to appear pink (Hence the name "Pink Tooth") (Fig. 16.6)

Mobility

Mobility associated with a deciduous tooth may be physiologic or may be due to any persisting pathology.



A



B

Figs 16.4A and B: A. Extraoral swelling seen in a young boy due to an infected lower second right molar; B. Extraoral sinus opening due to infection of lower right second deciduous molar



Fig. 16.5: Discolored non-vital upper deciduous central incisor

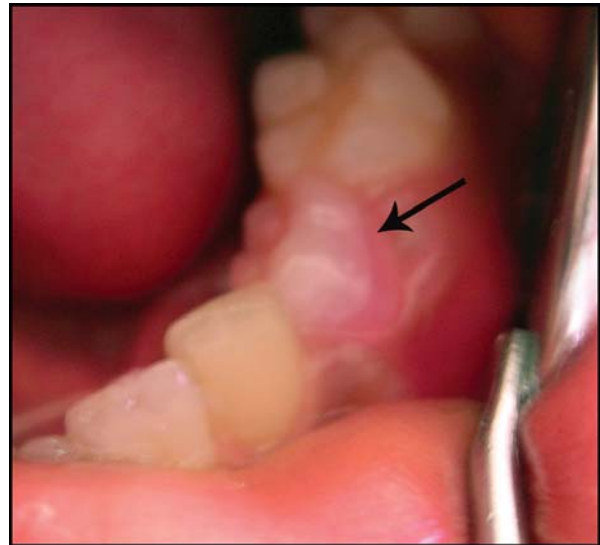


Fig. 16.6: Pink discoloration of the crown of the lower first deciduous molar due to internal resorption in the pulp chamber

Radiographic evaluation of the roots of deciduous tooth, the position of the developing tooth and amount of root completion of permanent tooth will determine the cause.

Pathological mobility is associated with pathologic root resorption/bone resorption.

Bone resorption is identified as radiolucency at the periapical or inter radicular region. It is not reliable to assess the degree of pathosis based on radiographic changes and mobility alone.

Vitality Tests

Pulp vitality tests, either thermal or electrical, are of little value in primary teeth. While they may sometimes give an indication of pulp vitality, the response does not identify the degree of pathosis present. Fear of the unknown may make the child patient apprehensive of the electric vitalometer and he or she may then give the response they feel is correct rather than an accurate one, thus making it very unpredictable. More importantly a normal healthy primary teeth may not respond to vitality tests.

The real value of vitality tests, either thermal or electrical, is in the permanent teeth where comparison can be made with normal antimeres. The obvious



example involves traumatized incisors, where serial testing may reveal the progress of the health of the pulp.

The pulp response may vary with recently erupted teeth, thickness of the tooth structure, presence of necrotic material, etc.

Radiographs

They provide information regarding the dental development, pathological entity, position of the permanent tooth bud, etc. One factor that must be remembered is that the lesion must be of sufficient dimensions to appear radiographically and must involve the cortical bone. Thus a lesion in its initial stages may go unnoticed.

Pathological entities that can be commonly observed are; pulp calcifications, internal resorption, external resorption, bone resorption all of which may alter the treatment plan.

- I. *Internal resorption (Fig. 16.7)*: It is associated with spontaneous pain at night and both the coronal and radicular pulp is inflamed. This contraindicates single visit pulpotomy and if the resorption is severe extraction may be the only choice.
- II. *External resorption (Fig. 16.8)*: Pathological resorption is invariably associated with non vital pulp and extensive inflammation in the supporting tissues which may lead to external resorption. The only viable treatment is pulpectomy or extraction.
- III. *Bone resorption (Fig. 16.9)*: It is associated with a non vital pulp and may range from mild to severe bone loss depending on the presence of the persisting irritation. The involved tooth may be mobile and the extent of mobility is directly proportional to the amount of bone loss. If the resorption is minimum, pulpectomy is the treatment of choice but when the bone loss is extensive, extraction may be the only option. The radiolucency in primary molars is usually seen at the furcation and not at the apex. This is due to-
 - Exudate cannot penetrate the fine branching ramification of the molar root canals.
 - Presence of accessory canals in the furcation region.
 - Porous and permeable pulpal floor.

- IV. *Pulp calcification*: Represents the pulp's response to a long-standing lesion and is associated with pulpal degeneration. This contraindicates single visit pulpotomy.

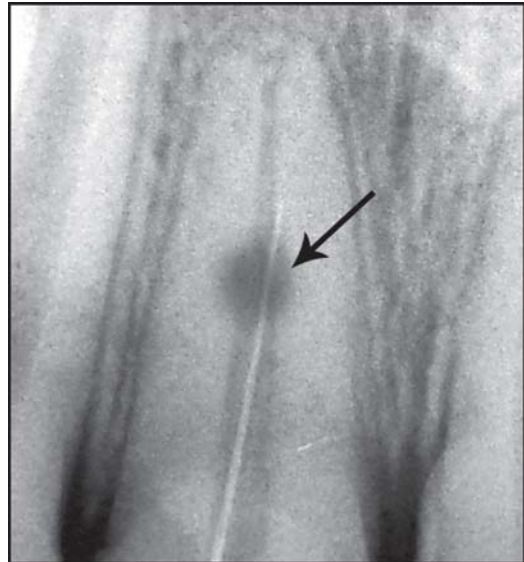


Fig. 16.7: Internal resorption seen with relation to upper central incisor

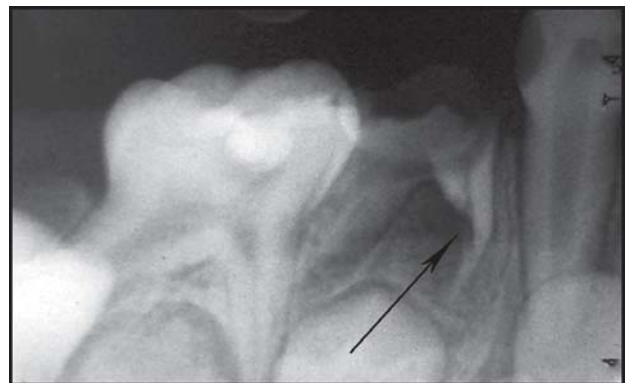


Fig. 16.8: External pathologic resorption seen with relation to distal roots of lower second deciduous molar

INDIVIDUAL TOOTH ASSESSMENT

The following questions should be answered before planning a treatment.

1. Can the tooth be restored back to function after pulp therapy is performed ? (Fig. 16.10)
2. Does the dental age of the child justify retention of the particular tooth? If the age of a child is above about 8 years it is very important to decide 'How

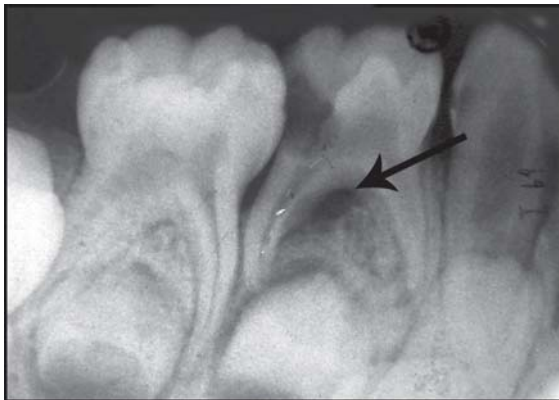


Fig. 16.9: Bone resorption in the deciduous molar is observed at the furcation whereas in permanent molars radiolucency is seen at the periapical region

long the tooth is going to stay in the oral cavity'. This depends on the dental age, amount of bone overlying the erupting permanent tooth.

3. Is the pulp status as such acquiescent to pulp therapy?



A



B

Figs 16.10A and B: Grossly decayed teeth which cannot be restored back to function is a contraindicated for any endodontic therapy; A. Radiograph of a lower second deciduous molar; B. Clinical picture of another case of a lower second deciduous molar with complete destruction of the clinical crown

Different types of pulp therapy

Deciduous teeth	Young permanent teeth
1. Indirect pulp capping	1. Indirect pulp capping
2. Direct pulp capping	2. Direct pulp capping
3. Pulpotomy	3. Pulpotomy/Apexogenesis
4. Pulpectomy	4. Apexification

Indirect Pulp Capping

Aim

To remove the infected dentin and leaving intact the affected dentin, so that the affected dentin will remineralize and act as a barrier above the healthy pulp.

Indications

- Deep caries in which the pulpal inflammation has been judged to be minimal and complete removal of caries would probably cause pulpal exposure.

Contraindications

- When there is wide spread inflammation or evidence of periapical pathosis.

Procedure (Fig. 16.11)

- Tooth is isolated with rubber dam.
- All the caries on the cavity walls and at the DEJ are removed, due to its closeness to the surface. Caries left in this area will likely cause failure due to the lateral spread.
- Large round bur or spoon excavator is used to remove the carious dentin. Round bur in slow speed is preferred, as there is more chance of removal of large segment of dentin with excavator
- Sedative dressing of calcium hydroxide is placed over the remaining dentin
- Tooth is then sealed with zinc oxide eugenol and amalgam
- The treated tooth can be re entered (if two step procedure is done) after 6-8 wks and remaining caries is removed. The pulp is safe from exposure, due to the formation of reparative dentin
- The color would have changed from red rose to light gray or light brown. The texture changes from spongy and wet to hard
- Tooth is then permanently restored with stainless steel crown.



Figs 16.11A to E: Indirect pulp capping:

A: Deep caries close to the pulp; B: Only infected dentin is removed leaving the affected dentin; C: Calcium hydroxide is placed over the affected dentin; D: Suitable base is placed over calcium hydroxide; E: Tooth is sealed with amalgam restoration

Affected Vs Infected Dentin

- Carious dentin is characterized by the presence of affected and infected dentin. Affected dentin forms the progressive front of the lesion preceded by the infected dentin. The infected dentin is characterized by the presence of microorganisms. The toxic

products from these microorganisms demineralize the dentin to form the affected zone (Affected dentin do not contain microorganisms and hence are sterile). During cavity preparation, attempt is made to remove the infected dentin leaving intact the affected dentin, using the clinical criteria of softening and discoloration.



- But in most of the cases, it is very difficult to clinically differentiate between the infected and affected dentin. Dyes can be used to differentiate the infected dentin from the affected dentin.
- Dyes used to differentiate affected and infected dentin are:
 - *0.5% solution of basic fuchsin in propylene glycol*: It is applied for 10 seconds. The outer or decomposed carious layer stains red. The inner or decalcified dentin does not take up the stain on short exposure
 - *1% acid red in propylene glycol*: Carious dentin stains dark red and the non carious dentin remains pink
 - *Mallory- Azan stain*: Outer layer stains red and the inner layer stains blue.

Direct pulp capping is less preferred in primary teeth because-

- Rapid spread of inflammation throughout the primary coronal pulp, due to increased blood supply. Therefore there is less chance that the infection will be limited to the exposed part of the pulp increasing the likelihood of rapid and widespread of bacteria.

Clinical success of direct pulp capping depends upon the following salient features

- Maintenance of pulp vitality
- Lack of undue sensitivity or pain
- Minimum pulp inflammatory response
- Ability of the pulp to maintain itself without progressive degeneration

Direct Pulp Capping

Definition

“Placement of a medicament or a non medicated material on a pulp that has been exposed, in the course of excavating the caries, due to fracture or due to mechanical exposures during routine caries removal”.

Indications

1. Mechanical exposures that occurs following trauma or during cavity preparation which is < 1 sq mm, surrounded by clean dentin in an asymptomatic vital deciduous tooth
2. Mechanical or carious exposures < 1 sq mm, in an asymptomatic vital young permanent tooth.

Contraindications

1. Cariously exposed deciduous teeth
2. Spontaneous pain
3. Swelling
4. Fistula
5. Tenderness to percussion
6. Pathologic mobility
7. Root resorption- external / internal
8. Periapical / interradicular radiolucency
9. Pulp calcifications
10. Profuse hemorrhage from the exposure site
11. Pus or exudate from exposure site

Treatment Considerations

Debridement: Necrotic and infected dentin chips will invariably be pushed into the exposed pulp, and this can impede healing, causing further pulpal inflammation.

Therefore it is very important to remove all peripheral caries. Following a clinical exposure a non irritating solution of normal saline or anesthetic solution should be used to cleanse the area and keep the pulp moist.

Hemorrhage and clotting: A blood clot formed after cessation of the bleeding, impedes the pulpal healing. Therefore care must be taken not to allow clot formation. The clot that is formed does not allow the capping material to contact the pulp tissue directly, or the clot material itself could breakdown, producing degradation products that act as substrate to the bacteria.

Bacterial contamination: Adequate seal following pulp capping is a must to prevent bacterial contamination. Stainless steel crown restoration is the most preferred one.

Procedure (Fig. 16.12)

- Adequate isolation
- Following pulp exposure, further manipulation of the pulp should be avoided



- Cavity is irrigated with saline and bleeding arrested with light pressure from sterile cotton pellet.
- Capping material is then placed over the exposure with minimum pressure and avoiding pushing the material into the pulp
- Cement base is placed over the medicament followed by restoring the tooth with amalgam and stainless steel crown.

Materials used for direct pulp capping

The material of choice is calcium hydroxide.

About 75% clinical success is observed when calcium hydroxide is used a pulp capping agent. Calcium hydroxide used may be having a neutral pH (Dycal) or alkaline pH (Pure CaOH_2 having pH of 11).



Figs 16.12A to D: Direct pulp capping; A. Pulp horns are high; B. Pulp horns exposed during cavity preparation; C. Calcium hydroxide is placed over the exposed pulp; D. Suitable base is placed over calcium hydroxide; E. Tooth is sealed with amalgam restoration



Histological changes

Following the use of alkaline calcium hydroxide as pulp capping agent (Fig.16.13A):

- Pulp in direct contact with calcium hydroxide (alkaline pH) becomes necrotic after 24 hours.
- Necrotic layer is separated from healthy tissue by a deep staining basophilic material – calcium proteinate
- Partially calcified fibrous tissue lined by odontoblasts is seen below the calcium proteinate zone in 14 days.
- A zone of new dentin is observed within 28 days.

Following the use of neutral calcium hydroxide (Dycal) as pulp capping agent (Fig. 16.13B):

- Pulp in direct contact with the material undergoes necrosis
- This necrosed tissue is removed by macrophages
- Granulation tissue are seen in the layer
- Odontoblasts are seen differentiating in the granulation tissue and form dentin.
- The dentin formed is in contact with the dycal. This makes it difficult to visualize the dentin bridge from the radioopaque dycal material.

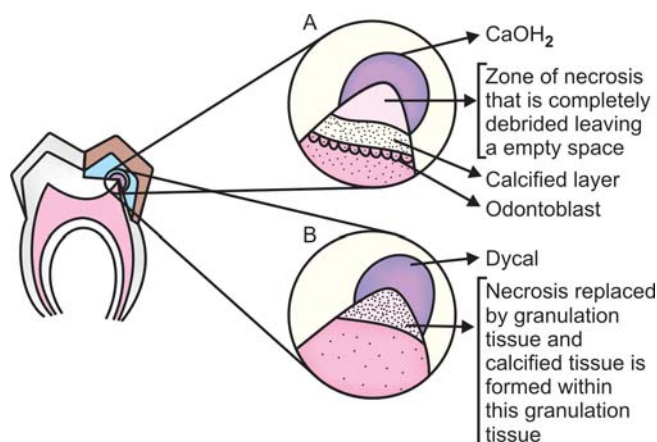


Fig. 16.13: Histological changes seen in pulp after placement of; A. Calcium hydroxide B. Dycal

Other materials used are:

1. Zinc oxide eugenol: no calcific bridge formation occurs.
2. Corticosteroids and antibiotics (Ledermix): Made of powder and liquid components. Powder

contains dimethyl chlortetracycline hydrochloride, triamcinolone acetonide, zinc oxide and calcium hydroxide.

Liquid is made of eugenol and rectified oil of turpentine.

3. Polycarboxylate cements
4. Tricalcium phosphate cement
5. Cyanoacrylate
6. Collagen
7. 4 META (4, Methacryl oxyethyl trimellitate anhydride) – soaks into the pulp, polymerizes and forms a hybrid layer.
8. Mineral trioxide aggregate (MTA)

Mineral Trioxide Aggregate

It is a new biocompatible pulp capping agent (MTA) and excellent results have been reported with its use. When compared with calcium hydroxide, MTA produced significantly more dentinal bridge in a shorter period of time with significantly less inflammation. Dentin deposition also began earlier with MTA. The disadvantage of this material is that it requires 3 to 4 hours for setting after placement. The procedure involves placing MTA directly over the exposure site and sealing the tooth temporarily to allow the cement to harden. The tooth is later reentered and permanently sealed over the set MTA with final restoration to prevent future bacterial microleakage. Although this approach requires an additional appointment, the results seem to justify the added time when pulp capping is the treatment of choice.

Pulpotomy

Definition

“Surgical removal of the entire coronal pulp, leaving intact the vital tissue in the canals, followed by placement of a medicament or dressing over the remaining pulp stump in an attempt to promote healing and retention of this vital tissue”.

Objectives

- To remove the inflamed and infected pulp tissue and allowing the vital pulp in the root canals to heal, thus maintaining the vitality of the tooth.



Indications

- Carious or mechanical exposure of vital primary teeth and young permanent teeth, where inflammation is restricted to coronal pulp only.

Contraindications

- History of spontaneous pain
- Swelling
- Fistula
- Tenderness to percussion
- Pathological mobility
- External/internal root resorption
- Periapical or interradicular radiolucency
- Pulp calcifications
- Pus or exudate from exposures site
- Uncontrollable bleeding from the amputated pulp stump
- > half root length resorbed

Types of Pulpotomy

- Devitalization technique
- Preservation technique
- Regeneration technique

Devitalization technique

In this technique the pulp undergoes devitalization.

Materials used – Electrocautery, laser and formacresol are commonly used.

Electrocautery: Carbonises and denatures pulp and eliminates bacterial contamination.

Laser: Creates a superficial zone of coagulative necrosis and this gets replaced by granulation tissue.

Formacresol: Buckley's formula or 20% formacresol is used. Formacresol fixes the tissue and renders it immune to bacterial attack.

Preservation technique

- In this technique minimum devitalization is present at the coronal portions of the pulp but not as severe and extensive as seen in devitalization technique. On the other hand it is non inductive as seen in regeneration technique.
- Gluteraldehyde, ferrous sulphate is used.

Regeneration technique

- This technique is inductive that is there is formation of calcific barrier or induces reparative dentin formation.
- Calcium hydroxide, BMP (bone morphogenic protein, has bone inducing property, so can be used to induce dentin also.)

Mortal pulpotomy

- It is a compromising treatment done on non vital primary teeth, where pulpectomy is not practical
- Necrotic coronal pulp is removed
- Infected radicular pulp is treated with strong antiseptic solution (Beechwood Creosote) for 1-2 wks.
- This is followed by replacement of antiseptic solution by an antiseptic paste.

Formacresol Pulpotomy

History: It was Sweet in 1930, who formulated the use of formacresol for pulpotomy in deciduous teeth and he recommended a multivisit technique. Multivisit technique was reduced to two visits by Doyle et al in 1962. The number of visits were subsequently reduced and in 1965 Spedding et al gave the presently used 5 minute technique.

Formacresol by its chemical structure is the combination of:

- Formaldehyde -19%
- Cresol - 35%
- Glycerin- 15%
- Water

Formaldehyde interacts with the protein portion of the cell and cresol enhances the action of formaldehyde.

Buckley's solution: The percentage of formacresol used is 20% (1/5 dilution) and was introduced by Buckley in 1904.

Preparation of Buckley's Solution:

To prepare 150 ml. Buckley's solution (1/5th dilution) 120 ml of diluent is prepared first and added to 30 ml. of full concentration formacresol.

Diluent (120 ml) –

3 parts glycerine (90 ml) + 1 part of distilled water (30 ml) = 120 ml.



Buckley's solution (150 ml) -

4 parts of diluent (120 ml) + 1 part of formacresol (30 ml) = 150 ml.

= 150 ml formacresol of 1/5th strength is thus prepared.

Success following formacresol pulpotomy

Clinical success = 90-100%

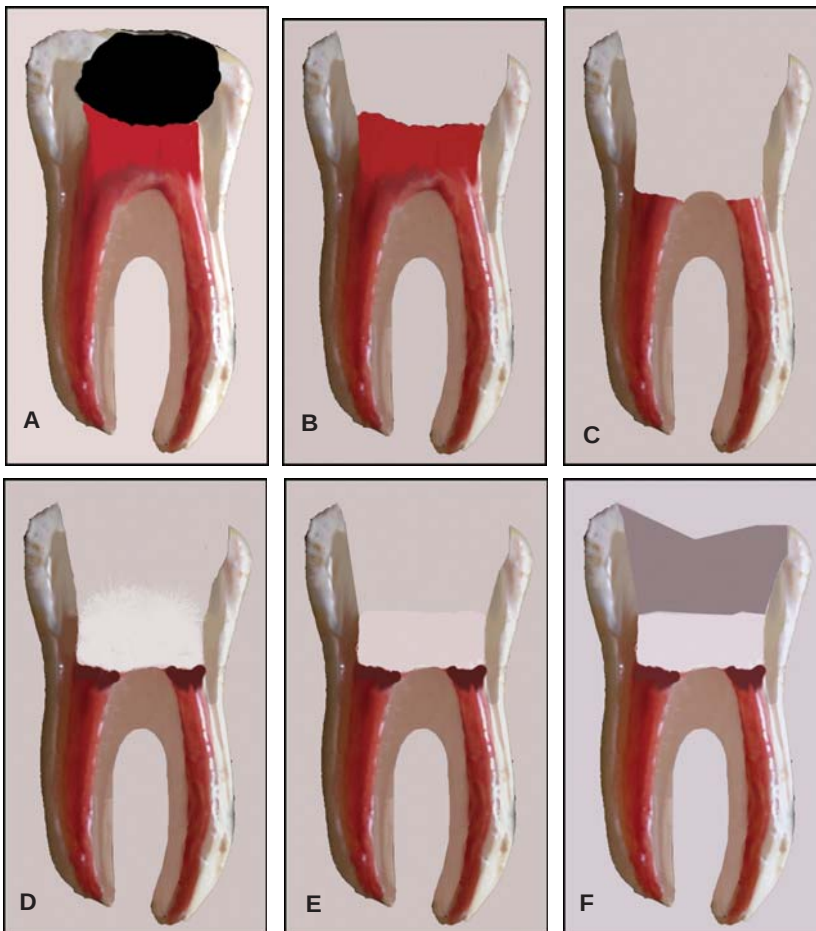
Histological success = 70-80%

Success depends on accurate selection of the case.

Procedure for Formacresol pulpotomy (Fig.16.14)

1. Administration of local anesthesia and rubber dam isolation.
2. All caries should be removed.
3. Entire roof of the pulp chamber is cut with high-speed bur and water spray.

4. The coronal pulp is removed with the round bur or spoon excavator.
5. Pulp chamber is washed thoroughly, to remove all debris.
6. Hemorrhage is controlled with cotton slightly moistened with saline, placed against the stumps of the pulp at the opening of the root canals. Bleeding should be controlled within 3-5 min.
7. Pulp status is assessed.
8. Cotton pellet moistened with 1/5th dilution formacresol is placed over the amputated pulp for 5 min.
9. When the cotton pellet is removed, the pulp stump must appear dark brown or even black, as a result of fixation.
10. Creamy mix of zinc oxide Eugenol is placed over the amputated pulp. Equal parts of formacresol can be added to eugenol. The tooth is then restored with stainless steel crown restoration.



Figs 16.14A to F: Formacresol pulpotomy; A. Caries extending upto the pulp; B. Access opening made; C. Coronal pulp removed; D. Formacresol pellet placed on the amputated pulp stump for 5 minutes; E. Zinc oxide eugenol mix is placed over the fixed pulp; F. Tooth is sealed with amalgam restoration



Histological Changes Following Formacresol Pulpotomy
As given by Massler & Mansokhani in 1959

Immediately following placement of the formacresol the pulp tissue became fibrous and acidophilic.

7-14 days later, 3 distinct zones appear. They are

- i. Broad acidophilic zone of fixation
- ii. Broad pale staining zone of atrophy with few cells and fibers
- iii. Broad zone of inflammatory cells extending apically from the border of the pale staining zone.

Progressive apical movement of these zones occurs and at the end of one year the entire pulp will be comprised of only the acidophilic zone.

Formacresol binds and renders tissue incapable of autolysis, but capable of replacement by granulation tissue.

Disadvantages of Formacresol

1. **Local toxicity:** There is no actual healing of the pulp and the tooth becomes devitalized.
2. **Systemic toxicity:** Studies have shown that full strength formacresol, is absorbed into the systemic circulation from the pulpotomy site. Excretion is via the kidney and lungs. Some amount of formacresol remains cell bound in the liver, kidney and lungs. Cytogenic and mutagenic effect is observed due to its ability to denature nucleic acids by forming methylol derivatives and methylene cross links. Formacresol is also said to produce irreversible damage to the protein portion of enzymes, genetic material, membranes, and connective tissue. It affects directly the protein biosynthesis and cell reproduction by interacting with DNA and RNA and destroys the lipid component of the cell membrane.
3. **Damage to succedaneous teeth:** It is seen that 1ml of formacresol diffuses through the apical foramen in 3 min. Thus there is high-risk for the formation of enamel defects in the permanent successor following the use of formacresol in a primary tooth.

Glutaraldehyde

It has been widely tested, to replace formacresol. Studies have shown that application of 2-4% produces rapid surface fixation of the underlying pulp tissue.

Attributes of Glutaraldehyde Over Formacresol

- Forms strong intra and inter molecular protein bonds leading to superior fixation by cross linkage.
- Diffusability is limited, thus reducing the apical extension of the material
- Excellent antimicrobial property
- Less dystrophic calcification
- Produces initial zone of fixation that does not proceed apically
- Readily excreted from the body. About 90% is eliminated in 3 days
- 15-20 times less toxic than formacresol and have little potential for chromosomal interference or mutagenicity.

Pulpectomy

Definition

“Removal of the entire pulp and subsequent filling of the canals of the primary teeth with a suitable resorbable material”.

Indications

1. Primary teeth with pulp inflammation extending beyond the coronal pulp
2. Roots and alveolar bone with minimum pathologic resorption
3. Primary teeth with necrotic pulp and or periapical abscess
4. Pus at the clinical pulp exposure site

Contraindications

1. Grossly destroyed tooth that is non restorable clinically
2. Periradicular involvement extending to the permanent tooth bud, where the risk of damage to the permanent tooth is high.
3. Root resorption – internal or external
4. Extensive mobility
5. Gross bone loss at the apex or at the furcation

Types of Pulpectomy

Pulpectomy can be of two types, single visit or multi visit pulpectomy depending on the number of appointments required.



Single Visit Pulpectomy

Single visit pulpectomy is generally carried out as an extension of pulpotomy procedure, probably as an on the spot decision, when hemorrhage from the amputated radicular pulp stumps appear dark red (normal healthy bleeding is bright red in color) and is uncontrollable which is indicative of an inflamed tissue (Fig. 16.15). Other indication of single visit pulpectomy is a tooth with history of spontaneous pain without pulp necrosis, abscess or a fistula.

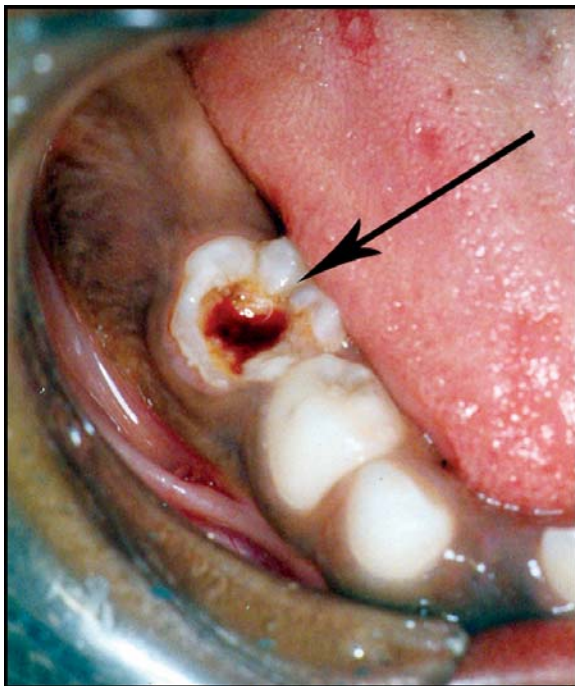


Fig. 16.15: Bleeding from inflamed vital pulp tissue

Procedure of single visit pulpectomy (Figs 16.16 to 16.19)

- Done under local anesthesia and rubber dam isolation
- All caries should be removed.
- Entire roof of the pulp chamber is cut with high-speed bur and water spray.
- The coronal pulp is removed with the round bur or spoon excavator.
- Pulp chamber is washed thoroughly, to remove all debris
- All accessible radicular pulp is removed with the broach. Care must be taken not to force the broach into the canal, as the barbs present in the broach can get caught to the canal wall and break inside the canal making it almost impossible to retrieve.
- Canals are enlarged with the aim of removing all the infected dentin and providing space for adequate obturation. No attempt is made to extend the instrument beyond the apex thus minimizing the risk of accidental injury to the permanent tooth bud.
- Hedstrom files are recommended since they remove hard tissue only on withdrawal, which prevents pushing infected material through the apices. The disadvantage of Hedstrom file is that it is weak and thus chances of breakage is high. K Flex files are stronger and hence are more resistant to fracture. Filing is done along with the use of lubricants. 5% sodium hypochlorite, hydrogen peroxide, saline etc are used for irrigation. The canals should be instrumented to the resistance point, that usually corresponds to 2-3 mm from the radiographic apex. Each canal can be enlarged 3-4 instrument sizes greater than the first file
- Radiograph with the endodontic instrument need not be taken for working length determination.
- Canals are irrigated with saline and dried. Paper points are used for drying the canal walls.
- Canals are then obturated with suitable resorbable filling material.
- Zinc Oxide Eugenol mix is placed over the obturating material
- Tooth is sealed with amalgam restoration and finally restored with stainless steel crown restoration

Multivisit Pulpectomy

- Used for non vital primary teeth with or without associated abscess (Fig. 16.20)
- Clinical technique is similar to single visit pulpectomy but all the procedures are not done on the first visit. On the first visit pulp is extirpated, canals are irrigated, dried and the tooth is temporarily restored. On the second visit the canals are enlarged and if all the symptoms have subsided the tooth is obturated and permanently restored. Obturation is postponed until the symptoms regresses.
- Between appointments, an antibacterial drug is sealed in the pulp chamber



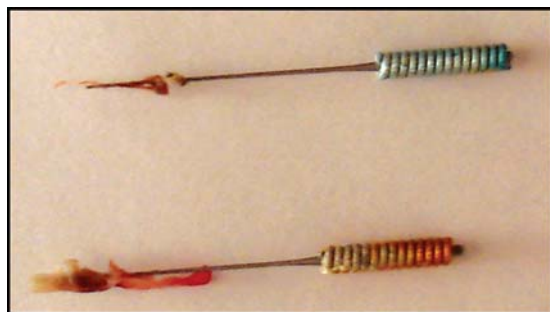
A



B



C



D



E



F

Figs 16.16A to F: Pulpectomy: A. Caries extending upto the pulp with apical abscess; B. Access opening made; C. Coronal and radicular pulp removed; D. Pulp that is extirpated using a broach; E. Canals obturated after debridement; F. Tooth is sealed with amalgam restoration.



Fig. 16.17: Canals should be irrigated regularly during mechanical debridement

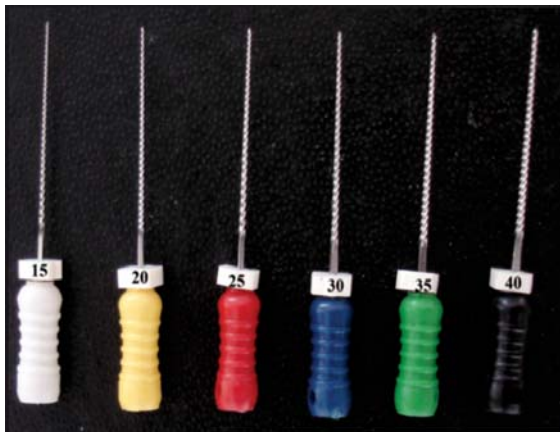


Fig. 16.18: Instruments are color coded based on the size. The color repeats in the same sequence for further instrument sizes, e.g. No. 15 instrument: White; No. 20 instrument: Yellow; No. 25 instrument: Red; No. 30 instrument: Blue; No. 35 instrument: Green; No. 40 instrument: Black



Fig. 16.19: Endodontic instruments used for canal debridement A: Barbed broach; B: H-files; C: K-files

- If pus is present, the canal can be left open to drain for 24 hrs
- Systemic antibiotics are advised if cellulitis is present
- The number of appointments, timing and extent of instrumentation thus will be determined by the signs and symptoms at each visit.



Fig. 16.20: Lack of bleeding from non vital pulp tissue site

Filling/obturation of deciduous root canals

Ideal Requirements of Material Used

- Must be resorbable
- Should not interfere with eruption of permanent tooth
- Should be bactericidal
- Must be radio opaque
- Must be non irritant

Different Materials Used

- Zinc oxide eugenol - is used without catalyst. Lack of catalyst is used to allow adequate working time.
- Iodoform paste - is also being used. It consists of zinc oxide and iodoform mixed into a paste. Its advantages over zinc oxide eugenol are
 - potent bactericidal



- non irritant
- radio opaque
- chemically active until entirely resorbed
- good healing properties
- rate of resorption is faster

Method of Obturation

- .. The canals are dried thoroughly using paper points (Fig. 16.21)
- .. Lentulo spiral (Fig. 16.22), pressure syringe, Jiffy's syringe, amalgam condensor, local anaesthetic syringe, tuberculin syringe, files etc can be used to carry and deposit the material into the root canal.
- .. The material is mixed to the required consistency and is carried and deposited in the canal just short of the apex.
- .. Cotton held with cotton pliers can be used as piston to push the material into the canal
- .. Pressure syringe is one of the best devices used for obturation for the following reasons.
 - avoidance of air trap
 - even amount of material is deposited
 - 300 psi force produced allows the use of thick consistency

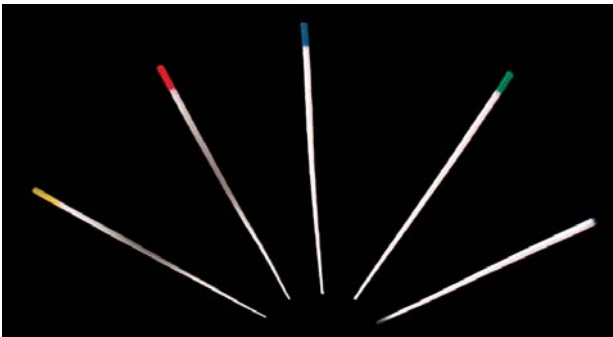


Fig. 16.21: Paper points are also color coded based on the size similar to the files/reamers/broaches

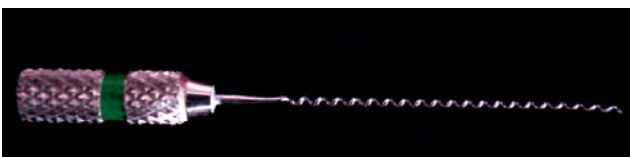


Fig. 16.22: Lentulo spiral used for obturating the canal

Common Problems With Zinc Oxide Eugenol as Deciduous Tooth Obturation Material

- Zinc oxide eugenol material is harder and resorbs slowly compared to the root. Thus a small fraction of the material always extends beyond the root and may cause inflammatory changes in the adjoining tissues.
- As the resorption reaches the pulpal floor, the permanent tooth may get deflected from its normal path of eruption due to the presence and obstruction from the bulk of zinc oxide eugenol.

Problems Encountered In Deciduous Tooth Pulpectomy

- Multiple ramification – makes complete debridement impossible
- Ribbon shaped or hour glass shaped canals – discourages gross enlargement of the canal.

In permanent teeth the objective of mechanical preparation is to provide an even circular apical 1/3. In primary teeth, attempt to prepare a circular apical 1/3 mechanically may result in lateral perforation of the canal, due to its hour glass shape.

Evaluation of Success of Pulpectomy

- No purulent discharge from the gingival margin
- No abnormal mobility
- No postoperative pain
- No further resorption of root (except physiological)
- Resolution of sinus tract, by 6 months

Follow-up

- Monthly evaluation should be done preferably for six months period.
- Clinical and radiographic assessment should be made postoperatively to judge the outcome of the treatment.
- Following pulp therapy, it is advisable to place stainless steel crown to prevent fracture.

If the succedaneous permanent tooth is missing, canals can be obturated with gutta percha.



Treatment Modalities for a Permanent Tooth with Extensive Involvement of the Pulp

Treatment modalities depends on the stage of development of the root and the vitality of the pulp

Permanent tooth with vital pulp and open apex: Apexogenesis (Calcium hydroxide pulpotomy), followed by root canal treatment and permanent restoration.

Permanent tooth with vital pulp and closed apex: Root canal treatment followed by permanent restoration.

Permanent tooth with non-vital pulp and open apex: Apexification followed by root canal treatment and permanent restoration.

Permanent tooth with Non vital pulp and closed apex: Root canal treatment followed by permanent restoration.

Apexogenesis (Calcium Hydroxide Pulpotomy) (Fig. 16.23)

Indicated in vital permanent teeth with large pulp exposures and incompletely formed or open apices (blunder buss canal).

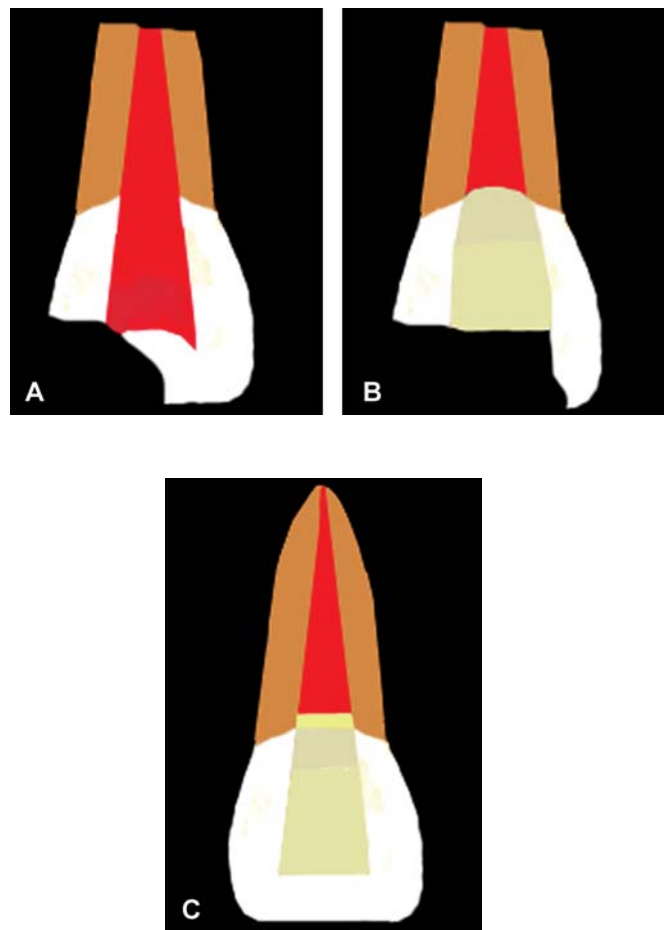
Aim

- To remove the infected coronal pulp and place calcium hydroxide over the healthy amputated radicular stumps
- A calcific barrier should form in response and the radicular pulp should retain its vitality so that root closure can occur.
- To achieve normal growth of the root to assume its normal length and apical closure.

Calcium hydroxide pulpotomy is considered as the first stage of treatment for vital cariously or traumatically exposed permanent teeth with incompletely formed apices.

The second phase of treatment following closure of the root apex is conventional root canal filling and permanent restoration. It is advisable to proceed with root canal treatment in permanent tooth as the second phase of treatment because; often there are linear calcifications along the length of the root canal after formation of a calcific bridge. This will progress until the

canal appears to be completely calcified radiographically. Microscopic evaluation reveals pulp remnants in between the calcifications that have become strangulated and non vital. Bacteria may migrate within these spaces to reach the periapical region resulting in periapical pathology. Once the canal has calcified to this extent, it may be impossible to negotiate it with instruments or EDTA and the choice of treatment is apical surgery or extraction. Thus to avoid similar post apexogenesis complications, root canal treatment is performed.



Figs 16.23A to C: Calcium hydroxide pulpotomy (Apexogenesis) procedure; A. Fracture of the tooth exposing the pulp in an immature tooth; B. Pulpotomy done using calcium hydroxide as the medicament; C. Root formation completed. Calcific bridge seen at the coronal end

Apexification (Fig. 16.24)

- Indicated in a non vital pulp with incompletely formed or open apices (blunderbuss canal). The toxic



products from the necrotic pulp causes death of the cells (Hertwig's epithelial root sheath) responsible for root growth, which reduces the chance of further root development and apical closure. It is almost impossible to get an accurate seal at the apex during obturation of a canal with wide open apex. Apexification is a procedure where a suitable material is placed in the root canal which aids in the formation of a calcific barrier at the apical end of the root canal acting as a natural seal. Calcific material that is formed may either be osteoid, cementoid or osteodentin.

Alternative to apexification is apical surgery preceded by root canal therapy. But this is not recommended in children because-

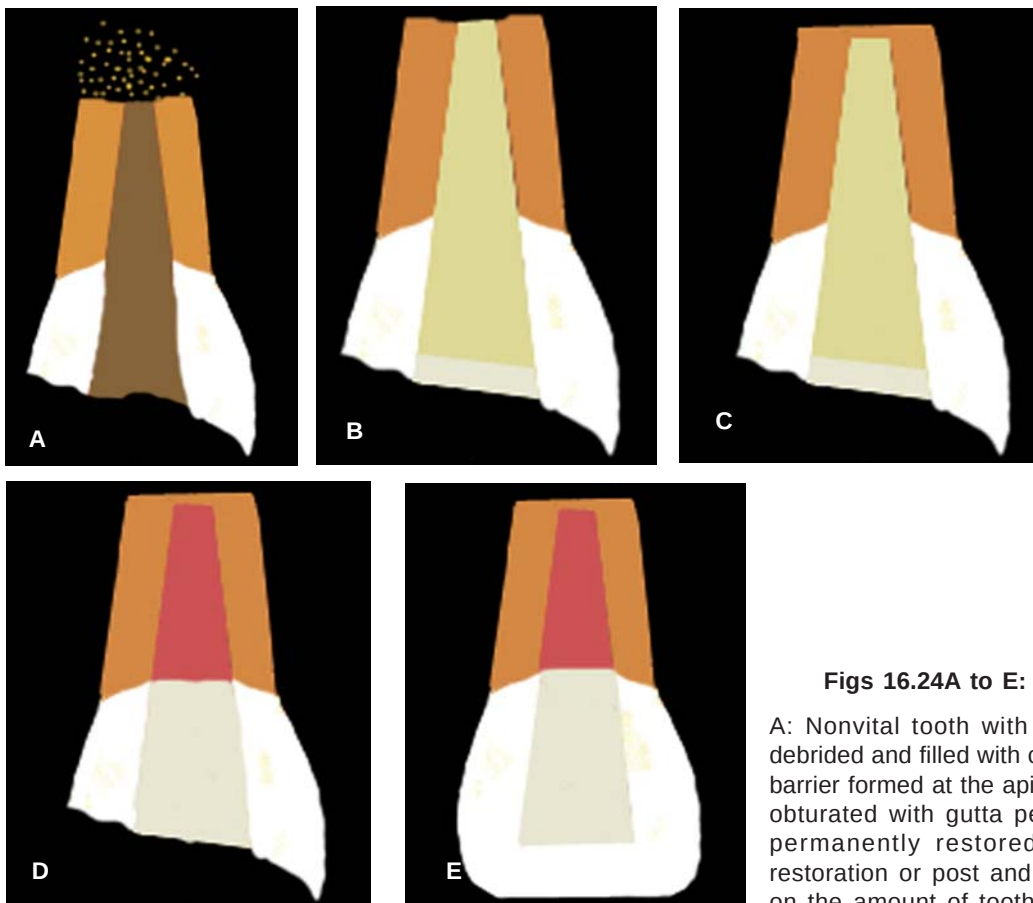
- Surgical techniques should be avoided
- Thin apical wall, may make apical surgery difficult
- Already short root may be further reduced by apical surgery

Material Used

1. Calcium hydroxide – Most preferred and first reported by Kaiser (1964) and popularized by Frank. It is mixed either with CMCP (camphorated parachlorophenol), saline, Ringer's solution, distilled water, anesthetic solution, etc.
2. Zinc oxide paste
3. Antibiotic paste
4. Tricalcium phosphate
5. Collagen – calcium phosphate gel
6. Mineral trioxide aggregate

Procedure

- The tooth is anesthetized and isolated.
- Access opening is similar to conventional root canal treatment
- Barbed broach is used to remove the pulp and necrotic debris



Figs 16.24A to E: Apexification procedure

A: Nonvital tooth with open apex; B: Root canal debried and filled with calcium hydroxide; C: Calcific barrier formed at the apical end; D: The tooth is then obturated with gutta percha; E: The tooth is then permanently restored either with plain crown restoration or post and core restoration depending on the amount of tooth material that is lost



- Diagnostic X-ray helps in assessing the root length (working length is approximately 2 mm from the apex)
- Hedstrom file is used along with constant irrigation to cleanse the canal off the debris
- Canal is dried and filled with calcium hydroxide or any other desired material
- Chances of success are greatly improved when the canal is filled in the absence of inflammation
- If acute signs are present, canal is debrided, irrigated and filled temporarily with antibacterial medicament like formacresol, beechwood creosote, CMCP or polyan antibiotic paste.

Follow-up

- Evaluation of signs and symptoms are made regularly. IOPA is taken once in 2-3 months, to evaluate the amount of root closure
- Root appearance can be compared with that of the antimere
- Calcific repair may be complete in 6 months to 2-3 yrs
- If there is failure to see any radiographic change after 1 year, the tooth has to be re-centered and calcium hydroxide must be replaced and X-ray taken to check the extent of calcium hydroxide in the canal
- Once the repair is complete, calcium hydroxide should be removed, canal irrigated and a root canal filling material placed
- Placement of posts within the canal should be avoided, as it weakens the remaining tooth structure
- Acid etched composite resin strengthens the tooth.

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Chapter 17



Trauma to the Anterior teeth and Its Management

1. Introduction
2. Epidemiology of Trauma
3. Classification of Trauma
4. Etiology of Trauma
5. Causes of Trauma
6. Predisposing Factors
7. Prevention of Trauma
8. Management
 - Clinical examination
 - Providing first aid
 - Treatment of the injury
 - Reaction of the injury pulp to trauma
 - Management of discolored teeth
 - Effects of trauma on development of succedaneous teeth
 - Prevention of trauma during contact sports



INTRODUCTION

A child is in a dynamic state of growth, both mentally and physically. He is curious about his surroundings and is always trying to explore, and due to his lack of motor coordination is more susceptible to fall and injury.

An injury to both the primary and permanent teeth and the supporting structures is one of the most common dental problems seen in children.

The extent of injury may vary from mild chipping of the enamel to severe maxillofacial injury. Trauma is also associated with psychological impact on both the parents and the child, since these fractures may alter the child's appearance and make him the target for teasing and ridicule by other children.

Trauma to the dentition should always be considered an emergency and dealt immediately and efficiently.

EPIDEMIOLOGY

Incidence

On an average about 30% of all school children suffer traumatic dental injury in primary dentition, whereas 22% suffer in permanent dentition.

So slightly about >50% children will sustain a traumatic dental injury before leaving school.

Site

Majority of the injury occurred to the anterior teeth and in particular to the maxillary central incisor.

71% of trauma cases involved the maxillary central incisor and this was 3 times more frequent than maxillary lateral incisor. Out of this 56% of them involved crown fracture without pulp involvement, 13% with pulp involvement and 3% with root fracture.

Sex Distribution

Both males and females equally showed highest number of incidence between the ages of 4-5 years.

In permanent dentition similar sex distribution continues until 9 years. After this, upto 11 years boys are twice as prone to injuries of the permanent dentition as girls.

CLASSIFICATION OF TRAUMA TO ANTERIOR TEETH (FIGS 17.1 TO 17.14)

Ellis Classification (1961)

- Enamel fracture
- Dentin fracture
- Crown fracture with pulp exposure
- Root fracture
- Tooth luxation
- Tooth intrusion.

Ellis and Davey Classification (1970)

- Class 1: Simple fracture of the crown, involving little or no dentin.
- Class 2: Extensive fracture of the crown involving considerable dentin, but not the pulp.
- Class 3: Extensive fracture of the crown involving considerable dentin and exposing dental pulp.
- Class 4: The traumatized tooth which becomes non-vital with or without loss of crown structure.
- Class 5: Loss of tooth.
- Class 6: Root fracture with or without loss of crown structure.
- Class 7: Displacement of a tooth without fracture of crown or root.
- Class 8: Fracture of crown enmass.
- Class 9: Traumatic injuries of deciduous teeth.

Hargreaves and Craig (1970)

Modified Ellis and Davey Classification

- Class I – No fracture or fracture of enamel only with or without displacement of the tooth.
- Class II – Fracture of the crown involving both enamel and dentin without exposure of the pulp and without displacement of the tooth.
- Class III – Fracture of the crown exposing the pulp with or without displacement of the tooth.
- Class IV – Fracture of the root with or without coronal fractures, with or without displacement of the tooth.
- Class IV – Total displacement of the tooth.



Hithersay and Morile (1982)

Recommended classification of subgingival fractures based on the level of tooth fracture in relation to various horizontal planes of the periodontium.

- Class 1 – Where the fracture line does not extend below the level of the attached gingiva.
- Class 2 – Where the fracture line extends below the level of attached gingiva, but not below the level of the alveolar crest.
- Class 3 – Where the fracture line extends below the alveolar crest.
- Class 4 – Where the fracture line is within the coronal third of the root but below the alveolar crest.

WHO Classification (1978)

- 873.60 – Enamel fracture.
- 873.61 – Crown fracture involving enamel and dentin without pulp exposure.
- 873.62 – Crown fracture with pulp exposure.
- 873.63 – Root fracture.
- 873.64 – Crown-root fracture.
- 873.66 – Luxation.
- 873.67 – Intrusion or extrusion.
- 873.68 – Avulsion.
- 873.69 – Other injuries like soft tissue injuries.

Andreasen's Modification (1981) of WHO Classification

- 873.64 – Uncomplicated/complicated crown-root fracture.
- 873.66 – Concussion/subluxation/lateral luxation.

International Classification of Diseases

Injuries to Teeth

- 1. Enamel infarction – N 502.50.
- 2. Enamel fracture, uncomplicated crown fracture – N 502.50.
- 3. Enamel – Dentin fracture, uncomplicated crown fracture – N 502.51.
- 4. Complicated crown fracture – N 502.52.
- 5. Root fracture – N 502.53.
- 6. Uncomplicated crown root fracture – N 502.54.
- 7. Complicated crown root fracture – N 502.54.

Injury to Periodontal Tissues

- 1. Concussion – N 503.20.
- 2. Subluxation – N 503.20.
- 3. Extrusive luxation – N 503.20.
- 4. Lateral luxation – N 503.20.
- 5. Intrusive luxation – N 503.21.
- 6. Avulsion – N 503.22.

Descriptive Classification

Previous classifications were numerical which tried to give various results of dental trauma a number. In this classification, it is easy to identify the exact problem. They are:

Injuries to the tooth

Crown:

- Crack or craze of enamel without loss of tooth structure
- Fracture of the crown involving enamel, dentin or pulp (horizontal or vertical)
- Fracture of the crown and root involving cementum and may or may not have pulpal involvement.

Root:

- Apical 1/3 fracture → may be horizontal or oblique
- Middle 1/3 fracture → may be horizontal or oblique
- Coronal 1/3 fracture → may be horizontal or oblique

Involving the whole tooth:

- **Concussion:** Sensitivity of the tooth due to trauma without abnormal loosening or mobility. The tooth may be sensitive to percussion usually caused due to mild blow.
- **Subluxation:** Loosening of the tooth without displacement, due to a more severe blow resulting in injury to periodontal ligament.
- **Displacement /luxation:**
 - **Intrusion:** Displacement of a tooth in an apical direction. Tooth is pushed into the socket, causing fracture of the bone at the floor of the socket in most of the cases.

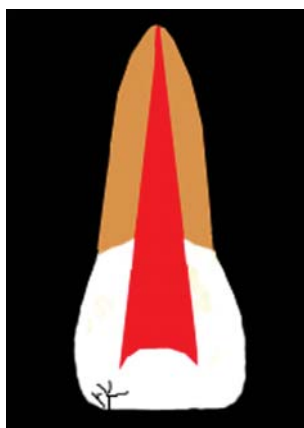


Fig. 17.1: Enamel crazing

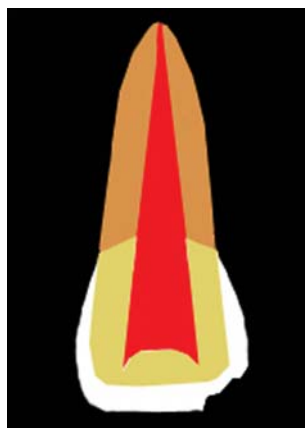


Fig. 17.2: Fracture involving only enamel

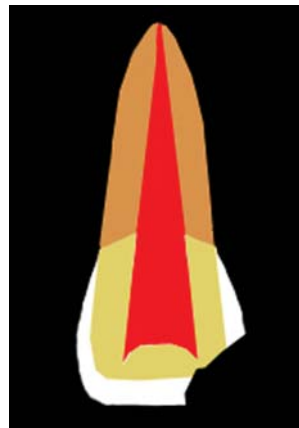


Fig. 17.3: Fracture involving enamel and dentin

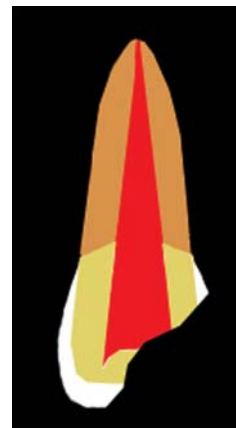


Fig. 17.4: Fracture involving enamel, dentin and pulp



Fig. 17.5: Tooth that has become non-vital following trauma with or without fracture



Fig. 17.6: Uncomplicated crown root fracture



Fig. 17.7: Complicated crown root fracture



Fig. 17.8: Apical one-third root fracture

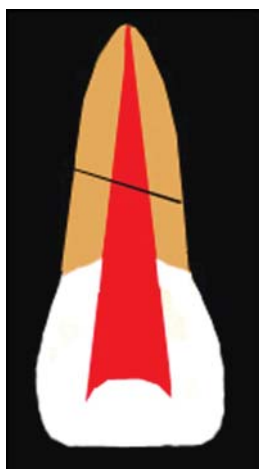


Fig. 17.9: Middle one-third root fracture



Fig. 17.10: Coronal one-third root fracture



Fig. 17.11: Fracture of crown enamel



Fig. 17.12: Extrusion

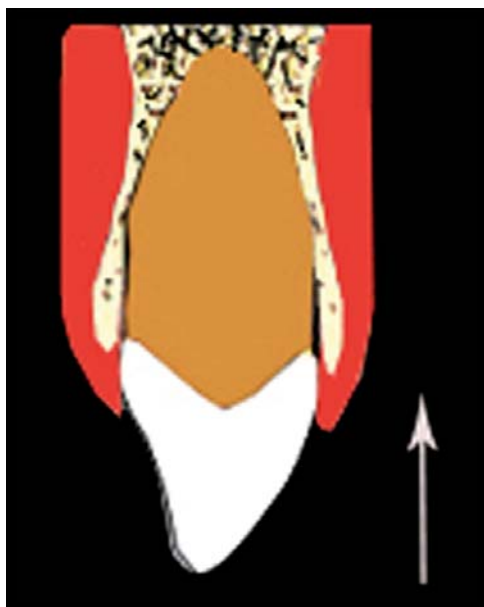


Fig. 17.13: Intrusion



Fig. 17.14: Lingual or palatal displacement of the tooth

- *Extrusion:* Displacement of a tooth in a coronal direction. The tooth is seen extruding out of the socket partially.
- *Labial/lingual/palatal:* Displacement of a tooth in a labial or lingual direction.
- *Lateral:* Displacement of a tooth in a mesial or distal direction.
- *Avulsion:* Loss of tooth, where the entire tooth is out of the socket.

Trauma to the Supporting Bone

- Fracture of alveolar socket – due to tooth intrusion
- Socket wall fracture – labial or lingual luxation
- Fracture of alveolar process
- Fracture of maxilla
- Fracture of mandible.

Soft Tissue Injury

- Contusion
- Abrasion
- Laceration
- Deep puncture wounds
- Wide loss of tissue

ETIOLOGY OF TRAUMA

Etiology of trauma may be categorized into the following:

1. Domestic violence – child abuse and neglect
2. Sporting activities – contact sports, bicycle or horse riding
3. Others – road accidents, falls or collisions, assaults, handicapped children.

Trauma or injuries can also be grouped into intentional (e.g., abuse) or unintentional (e.g., sporting activity).

Injury to the dentition can be due to direct or indirect trauma.

Direct: When the dentition is struck directly by one of variety of objects such as a hard ball, stick, fist, etc.

Indirect: Blow to the chin may cause sudden forceful closure of mandibular teeth with their maxillary opponents, as may follow a fall, a fight or road accident.

Dental injury in young children is usually due to lack of motor coordination, i.e. during the first year of life as due to fall when the child learns to walk.



18 Month – 2 Years

The children are notoriously adventurous and inquisitive. In primary teeth, injury usually results in displacement or avulsion of teeth rather than fracture.

Fracture of the tooth is rarely observed, due to the more vertical placement of tooth, better lip protection and more pliable alveolar bone, all these yielding more readily to tooth displacement by the blow.

2-5 Years (Toddler)

At this age children are learning to walk and are very much unsteady on their feet and may result in a fall injury to anterior teeth. Common injury at this age is because of the swing, which is usually at the level of the child's teeth. The child stands in front of a moving swing and receives a blow from the moving swing.

5-10 Years

Play ground accidents, bicycle accidents are common, resulting in multiple crown fracture associated with soft tissue injuries to the upper lip and chin.

>10 Years

Injury is due to contact sports, horse riding, road traffic accidents, etc.

When a child comes with injury "Battered child syndrome" (Child abuse) must be considered. Features include:

- ◆ Children usually are under 3 years of age or are very scared and submissive.
- ◆ Presents some hours or days after accident.
- ◆ Oral trauma whose history does not coincide with clinical findings.
- ◆ Multiple bruising over the body differing in shade.
- ◆ Facial scarring, burns or bite marks.
- ◆ Other fractures.

Details about child abuse are discussed in chapter 18.

PREDISPOSING FACTORS

Accident Prone Profile

- a. Class II division 1 malocclusion
- b. Class I type 1 malocclusion

Inadequate Lip Coverage

As observed with incompetent lip, short upper lip, mouth breathing habit, etc. Dental injuries are twice as frequent in children who have a protrusive malocclusion than those who have normal occlusion.

According to Jarvinen (1958) frequency of injury with:

- A. Normal overjet (0-3 mm) is 14.2%
- B. Increased overjet (3.1-6 mm) is 28.4%
- C. Extreme overjet (>6 mm) is 38.6%

Handicapped Children

Children with cerebral palsy, mental retardation or epilepsy are more susceptible to injuries, due to the following reasons:

- They are subjected to abnormal muscle tone and function in the oral area, producing protrusion of maxillary anterior teeth.
- Because of their poor skeletal muscle coordination they are subjected to frequent fall.
- In epileptic patients, during seizures there is increased chance of trauma due to fall.

Dental Anomalies and Caries

Hypoplasia and dental caries results in weakening of the crown structure.

Mechanical Factors

According to Hallet (1953), severity of injury depends on:

Energy of Impact

Energy of impact depends upon both mass and velocity. *For example*, force of high velocity and low mass = gun shot injury;



High mass and low velocity = striking the tooth against the ground.

Low velocity blows cause greater damage to supporting structures and high velocity blows results in crown fractures.

Resiliency of the Impacting Object

If a tooth is struck with a resilient or cushioned object such as an elbow during play or if the lip absorbs and distributes the impact, the chance of crown fractures is reduced while the risk of luxation and alveolar fracture is increased.

Shape of the Impacting Object

A sharp impact favors clean fractures with minimum of displacement of the tooth because energy is spread rapidly over a limited area. On the other hand, a blunt impact increases the area of resistance to the force in the crown region and allows the impact to be transmitted to the apical region causing luxation and root fracture.

Angle of Direction of the Impacting Force

The impact can meet the tooth at different angles, most often hitting the tooth facially, and perpendicular to the long axis of the root. It may result in cleavage lines along with the main fracture line. It is seen that enamel is weakest parallel to enamel rod and dentin is weakest perpendicular to the dentinal tubules.

PREVENTION OF TRAUMA

1. *Legislation*: Compulsory use of mouth guards, seat belts, helmets, etc.
2. *Education*: Explaining the potential dangers.
3. Early recognition and treatment of predisposing factors.

MANAGEMENT

It includes:

1. Obtaining history
2. Clinical examination
3. Providing first aid
4. Treatment of the injury.

Obtaining History

History taking is one of the fundamental steps in routine clinical dentistry. It should be done precisely and quickly, followed by a thorough examination.

History taking includes:

1. Personal data – name, age, sex, address
2. Complaint and its history – can be related to pain, sensitivity, discomfort, etc. Pain occurring when teeth are in contact, may be due to displaced tooth. The severity of tooth mobility following trauma and chances of pulpal death is directly proportional. Pain caused by thermal change signifies pulpal inflammation.
3. Relevant medical history and history of tetanus prophylaxis should be recorded.
4. Previous dental history.
5. Neurological history – trauma may result in damage to cranial nerve. Patient is observed from the time he/she enters the dental office. Signs and symptoms suggestive of neurologic damage are:
 - Inability to sit or stand unsupported
 - Patient appears lethargic or confused
 - Presence of black eye
 - Unusual verbal response to questions
 - Nausea or vomiting
 - Headache
 - Bleeding or discharge of clear fluid from ears and nose
 - Abnormal position or movement of eye
 - Perspiration on the forehead
 - Asymmetric or decreased reaction of pupil
 - Abnormal respiratory rate
 - Level of consciousness.

Clinical Examination

Assessment of Injury

It may be difficult in a very young child who is frightened and shocked following his accident to make him sit on a dental chair for check up. The injury can appear alarming to the mother. A little blood mixed with saliva can give the impression of copious hemorrhage and clotting of the blood on lips can suggest extensive laceration.



For an adequate clinical assessment in young children or infants – visual access to the mouth can be improved if the mother and the pedodontist sit facing each other on an ordinary chair, with the child's head on the lap of the pedodontist and legs stretched on to the mothers lap. The mother holds the child's hands with her own. Both the upper and lower arches can be readily seen and if needed mouth prop can be used. The area to be examined is cleaned with cotton moistened with hydrogen peroxide or water.

Extraoral Examination

- Hemorrhage – sub-conjunctival hemorrhage may indicate fracture of zygomatic complex.
- Laceration – inspected for foreign bodies or broken tooth fragments
- Deviation in the path of mandible during mouth opening, will reveal injury to the TMJ.
- Leakage of straw colored fluid from nose, indicates fracture of the middle 1/3.

Intraoral Examination

Soft tissues examination:

- Laceration of gingiva, labial and buccal mucosa, tongue and floor of the mouth.
- Presence of embedded tooth fragments.
- Hematoma in the floor of the mouth indicate mandibular fracture.

Hard tissues examination:

- Occlusal abnormalities, which may be due to fractured dentoalveolar portion or displacement of the teeth.
- Palpation of maxilla and mandible for fracture. Mandibular fracture signs are local swelling, ecchymoses, malocclusion, and limited ability to open the mouth.
- Displacement of teeth has to be measured in millimeters.
- Mobility can be in horizontal or vertical direction. If 2 or more teeth move at a time, alveolar fracture must be suspected.
- Root fractures can be diagnosed by placing fingers against the linguopalatal and buccolabial mucosa and

attempt is made to move the tooth. If independent movement of crown and root is detected, root fracture is suspected.

- Type of fracture is classified
- Color change of the crown is noted:
 - If the crown appears darkened, there are high chances that the tooth is non-vital
 - Reddish crown indicates pulpal-hyperemia, may later undergo degenerative changes terminating in pulpal necrosis.

Vitality Tests

Pulp testing by any of the conventional methods is not advisable as the response from a young child cannot be relied upon, and is of little value because a tooth that gives false responses following a trauma, may recover vitality after sometime.

Following fracture, reactions to pulp vitality test may be negative for as long as 6-8 weeks. It is possible for trauma to injure pulpal nerves and not the blood vessels. In such a case the pulp would be healthy in having a normal blood supply, but would not respond to the stimuli. Healthy pulp responds to electrical stimulus of 150 μ Amp from a monopolar pulp tester and > 200 μ Amp may excite periodontal nerves.

Recommended pulp testing – immediately, 2 weeks, 1 month, 2 months, 6 months, 12 months and then at yearly interval for next 3 years. Pulp that does not show any response by the end of 1 month, may be undergoing degeneration.

Providing First Aid

- Trauma of the orofacial region can cause profuse bleeding into oropharynx and nasopharynx, creating respiratory obstruction. It is essential to maintain the airway. If needed endotracheal intubation or tracheostomy may have to be performed.
- Deep cuts and lacerations should be sutured using chromic gut sutures (2-0) or black silk under LA.
- Fluid replacement is necessary to avoid hypovolemic shock.
- Adequate debridement of the area is important. Gentle cleaning and irrigation with normal saline



solution will help to reduce the amount of dead tissue and risk of anaerobic condition. Topical antiseptics should be used to reduce the bacterial count especially the pathogenic streptococci and staphylococci in skin or mucosa at wound site. For example, chlorhexidine, iodine, phenol, sodium hypochlorite, etc.

Tetanus prophylaxis: The following regime is as follows:

- Immunization completed previously: Booster dose within 12 months – No additional toxoid (TT) required.
- Immunization completed within previous 10 years – administer 0.5 ml fluid tetanus toxoid booster (intramuscular).
- Immunization completed >10 years, last booster within previous 10 years – administer 0.5 ml TT intramuscularly.
- Immunization completed >10 years previously, no booster received within last 10 years – wound cleaned, treated promptly and adequately, 0.5 ml T.T given intramuscularly.
- Immunization completed > 10 years previously, no booster within last 10 years, wound tetanus prone – administer 0.5 ml TT and 250 ml tetanus immune human globulin.
- No history of immunization, wound not clean or treated promptly – 250-500 units tetanus immune human globulin and 0.5 ml absorbed TT prophylactic use of penicillin should also be advised.

TREATMENT OF THE INJURY

Trauma to the Primary Teeth

Due to the proximity of the developing succedaneous tooth, definitive treatment of the traumatized primary tooth should be instituted as soon as possible. Extent of damage to a permanent tooth depends on its developmental status at the time of injury besides the nature, extent and duration of injury to primary tooth.

Enamel Fracture

In small enamel fractures – rough enamel margins can be disked and smoothened.

In large enamel fractures – the tooth may be restored using an acid etch composite resin restoration.

Enamel and Dentin Fractures

Exposed dentin should be covered with a layer of calcium hydroxide or glass ionomer cement to prevent pulpal irritation. The tooth is then restored with acid etch composite resin restoration or by preformed polycarbonate crown or by fabricated acrylic jacket crown.

Fracture Involving the Pulp

Usually such injuries are rare in primary dentition. Treatment depends upon the vitality of the tooth. If the tooth is vital the treatment option may vary from direct pulp capping to formacresol pulpotomy. If the tooth is non-vital, pulpectomy is the choice. Final restoration is done with a celluloid crown matrix or a stainless steel crown with composite facing or window.

Root Fracture

In a primary tooth with root fracture without dislocation and excessive mobility, normal exfoliation may be anticipated. Extraction is preferred if the tooth is very mobile as it is associated with increased risk of aspiration.

Treatment depends on the level of fracture.

Apical 1/3 fracture – is associated with good prognosis. The tooth usually maintains its vitality and normal root resorption occurs.

Middle 1/3 and coronal 1/3 fractures– advised extraction.

Concussion: The tooth should be made free from occlusion and is kept under observation.

Mobility: This type of trauma is very common in children. Patient is instructed to avoid eating with involved teeth and follow-up examination should occur. The bone can be remodelled around the teeth with gentle finger pressure sufficient to hold the teeth in a fairly stable position as the bone is very spongy and malleable. No splint should be placed and prognosis is good.

Intrusion: It is one of the most dangerous injuries to the developing permanent tooth bud. If the intruded deciduous tooth is contacting the permanent tooth bud, the deciduous tooth must be extracted. If it is not



contacting and is placed labially, the intruded tooth is allowed to re-erupt. 90% of the teeth reerupt in 2-6 months. The tooth is kept under observation. Extraction of the intruded tooth is indicated if a fistula or a periapical radiolucency develops or does not erupt after 3-4 weeks.

Extrusion and lateral luxation injuries: In these injuries, serious damage to the PDL usually occurs. Some clinicians recommend splinting these teeth with sutures until periodontal ligament attachment occurs, which takes approximately 2 weeks. While few others prefer extraction because of the potential for aspiration of the mobile teeth or subsequent damage to developing permanent tooth bud.

Splinting of luxated primary teeth is not preferred because:

- Cooperation is often a problem
- Bonding of the splint is difficult due to short clinical crowns and associated gingival bleeding.

Avulsion: Primary teeth that have avulsed should not be reimplanted. The lost tooth is replaced by an artificial substitute.

Trauma to the Permanent Tooth

Treatment options of crown fractures is directly related to

- Pulpal response to injury or restorative material
- Restorative considerations for final or definitive treatment.

Final restorative treatment for a traumatized permanent anterior tooth include:

- Recontouring the injured or opposite tooth
- Composite or adhesive resin restoration
- Reattachment of the original crown fragment
- Laminate veneers
- Porcelain fused to metal crowns
- Full coverage porcelain restorations
- Bleaching

Crown Craze Or Crack (Fig. 17.15)

These are minute cracks extending throughout the labiolingual surface, usually resulting from direct impact

forces to a tooth. These crazed areas may involve enamel alone or both enamel and dentin.

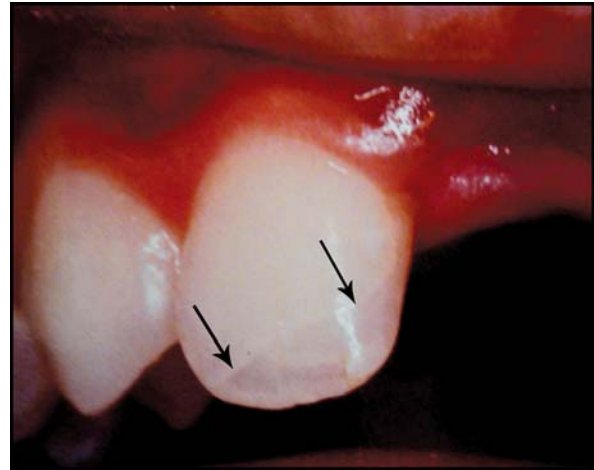


Fig. 17.15: Enamel craze line seen on the upper lateral incisor

The width of the cracks are not much larger (2-5 mm) than most bacteria and they tend to become filled and sealed which is the reason why these cracks do not contribute to caries formation. But they weaken the tooth and may lead to tooth fracture.

Such cracks usually go unnoticed. Transillumination may be helpful in detection. Staining the teeth with a disclosing solution will often reveal the fracture after the residual dye is washed away. Lines of infraction exhibit a coronal pattern, depending on the direction of the force and the site of impaction.

Application of cold will elicit pain and with an electric pulp tester the tooth often responds to slightly less current than usual.

Occlusion should be corrected. The tooth is kept under observation for vitality. Infraction lines can be sealed with unfilled resin, to prevent stains.

Fractures Involving Enamel (Fig. 17.16)

Treatment consists of smoothening the jagged edges if there is only slight chipping of the enamel. Restoration of the fractured fragment is made using acid etch composite resin restoration. The tooth should be kept under observation for 6-8 weeks for any changes in the pulp or periapical region that may occur due to deleterious effects of concussion on pulp.



Fig. 17.16: Enamel fracture that can be restored with composite restoration

Fractures Involving Enamel and Dentin (Figs 17.17 and 17.18)

Although pulp is not visibly exposed, emergency treatment is necessary to protect the already traumatized pulp from further insult from excessive thermal, bacterial and chemical stimuli and to hasten the formation of a layer of secondary dentin in the fractured area. Dentin thickness of 2 millimeters is needed to shield the pulp. Dentinal tubules closer to the pulp are wider, therefore making it easier for the penetration of microorganisms or noxious substances. Thus deep fractures will allow more microorganisms or other substances in higher concentrations to permeate through the dentinal barrier and provoke and inflammatory response in the pulp.



Fig. 17.17: Class II fracture of the crown



Fig. 17.18: Pin retained restoration of anterior tooth

Methods of Treatment for Enamel Dentin Fractures

- Acid etch composite/crown restoration
- Reattachment of the fracture fragment
- Pin retained composite restoration.

Acid etch composite/crown restoration: The traditional approach includes placement of calcium hydroxide over exposed dentin, followed by acid etch composite resin restoration. This is recommended when dentin thickness is <0.5 mm ($500\mu\text{m}$). Glass ionomer cement is also used instead of calcium hydroxide as sealing material.

The dressing is held in place using orthodontic band, celluloid crown, and stainless steel crown or by acid etch composite resin restoration.

Stainless steel crowns are not esthetically pleasing, but are extremely sturdy and durable. It is a useful restoration in cases where the fracture is close to the gingival margin and isolation is difficult and also in cases of horizontal fractures where the strength of the stainless steel crown is of great advantage. To improve esthetics a labial window can be made with a diamond bur using an air turbine. The crown must remain in place until a vital response is noted which may be for about 7-8 weeks following injury. It may then be replaced by a permanent restoration.

Reattachment of the fractured fragment: It is possible to successfully reattach the teeth fragment using resin and bonding technique. These fragments serve as esthetically perfect temporary restorations that may be retained for a long time and also no mechanical tooth preparation is needed, as the fragments are retained



by enamel etch technique. If a considerable portion of dentin is exposed, modification of the fragment is done to provide space for the dressing material by removing a portion of dentin using a bur.

Pin retained composite restoration: A period of 8 weeks is allowed after injury for the pulp to recover from injury. Pin retained composite resin restorations are placed at one sitting and are esthetically satisfactory. The pins are placed in holes drilled in the dentin and serve to retain the composite restoration. Pins are usually avoided in young permanent tooth as the thickness of the dentin is very less and risk of pulp damage is high.

Advantage of calcium hydroxide as a dressing material over exposed dentin:

- Reduce or neutralize the acidity of cements
- Increases the local pH, provides an antimicrobial environment
- Protects the pulp by occluding open dentinal tubules
- Stimulates reparative dentin formation.

Disadvantages of calcium hydroxide

- It is soluble in water, therefore the presence of dentinal fluid may interfere with the set of the material and cause eventual dissolution.
- Soluble when exposed to 37% phosphoric acid for 60 seconds as during composite resin restoration.

In a vital dentin (dentin with dentinal tubular fluid and odontoblastic processes) during acid etching the extent of acid penetration into dentin is limited, and is not more than $10\mu\text{m}$. In a non-vital dentin it is about $200\mu\text{m}$ (0.2mm).

Glass Ionomer Cement as the Material to Seal the Exposed Dentin, below the Composite Resin Restoration

Materials used to seal dentinal tubules must be hydrophilic. Fluid flow from the tubules assist in diluting harmful chemicals or microbial products and provide a fluid movement force against which the bacteria must travel to gain access to the pulpal tissue. But this fluid affects the adherence or bonding of composite which

is hydrophobic. This is not a problem with glass ionomer as it is hydrophilic. The advantage of glass ionomer cement is that it is hydrophilic, releases fluoride, chemically adheres to enamel and dentin and also has a coefficient of thermal expansion similar to dentin. Also etching glass ionomer cement does not adversely affect its properties if the minimum thickness is 0.5 mm and freshly prepared.

Fracture Involving the Pulp (Fig. 17.19)



Fig. 17.19: Class III fracture of the crown

Treatment depends upon following factors:

1. *Size of pulpal exposure:* Small pulp exposures can be managed by direct pulp capping or Cvek pulpotomy
2. *Stage of development of root apex:* The treatment procedure should be aimed at maintaining the pulp vitality.
3. *Vitality of the pulp:* Vital procedures such as direct pulp capping or pulpotomy are preferred.
4. *Time lapse:* Shorter time lapse after trauma is favorable to initiate any vital procedures. Thus prognosis of direct pulp capping is good when done immediately than done after few days.

Objectives of the treatment:

1. Retain the tooth
2. Maintain its vitality, to allow apex closure in a young permanent tooth
3. Ensure root apex maturity.

Usual treatment modalities:

1. Pulp capping
2. Pulpotomy



3. Pulpectomy
4. Apexification
5. Extraction.

Pulp capping or partial pulpotomy should be done immediately in an immature tooth for better prognosis, so as to maintain its vitality.

Contamination of the pulp tissue by oral fluids directly inoculates this tissue with bacteria. Therefore the majority of complicated crown fractures require partial or complete pulpotomy.

Please refer chapter 16 for details on pulp therapy.

Pulp Capping

Indicated in fractures associated with exposure of pulp and the exposure is small and not over 24 hours in duration. It is also indicated in a tooth with, incompletely formed apex.

The involved tooth is isolated with rubber dam and calcium hydroxide is placed over the exposed pulp. The tooth is then restored with a stainless steel crown or acid etch composite resin restoration. A thin layer of dentin like material should cover vital pulp tissue within 2 months.

There is some risk of failure as infection of the pulp is inevitable even with a minute exposure.

Partial Pulpotomy (Shallow Pulpotomy/ Cvek Pulpotomy) (Fig. 17.20)

It was advocated by Cvek in 1978. It is a definitive procedure that allows root closure and maintains pulpal vitality. It involves removal of 2 mm of injured coronal pulp with a sterile bur in a high speed handpiece cooled with sterile solution. Calcium hydroxide dressing is placed over the residual tissue and sealed with zinc oxide eugenol cement or glass ionomer cement. When there is radiographic evidence of development of a hard tissue barrier (3-6 months), the tooth is restored with acid etch composite resin after removing the zinc oxide eugenol cement. Cvek reported 96% success rate with this technique regardless of the stage of root development, contamination by oral fluids (upto 7days) or size of the original exposure (upto 4 mm.)

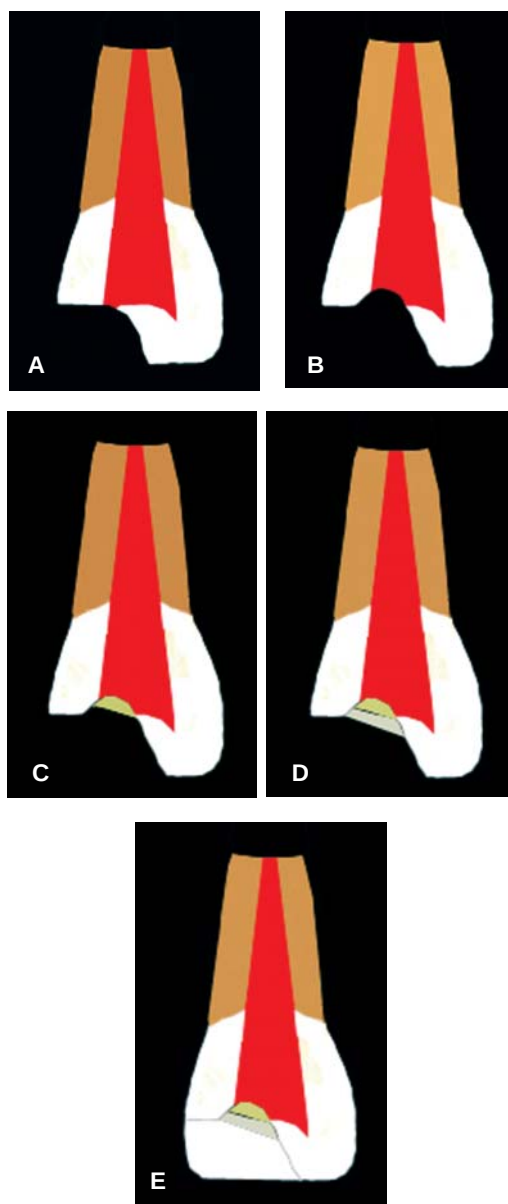


Fig. 17.20: Cvek Pulpotomy A: Trauma involving enamel, dentin and pulp in an immature tooth with vital pulp, B: Part of the coronal pulp is removed, C: Calcium hydroxide is placed over the amputated pulp, D: The tooth is then sealed with zinc oxide eugenol or glass ionomer cement, E: The tooth is then restored with comparator resin

Pulpotomy

Indicated when there is moderate hemorrhage with a relatively large pulp exposure and patient is seen within 48 hours. An incisor with a wide apex and incomplete



root formation is considered a good candidate for this technique because of the better recuperative powers of the young pulp.

Pulpotomy is contraindicated in a mature teeth with concurrent displacement injuries (as these procedures require the maintenance of an intact vascular supply and displacement injuries frequently involve vascular damage), teeth with other types of vascular alterations like pulpstones, degeneration or inflammatory changes and in tooth with extensive fracture requiring posts.

This procedure involves removal of the infected coronal pulp tissue leaving vital, non-infected radicular pulp tissue allowing complete apex formation.

Pulpectomy

It is indicated if the pulp is degenerated, putrescent, of questionable vitality or if the exposure period is >72 hours.

Apexification

It is the treatment of choice in the management of immature necrotic permanent teeth. It is followed by conventional root canal treatment in the management of teeth with irreversibly diseased pulp and open apices. There is formation of calcific barrier just coronal to the apex, following which routine endodontic procedure may be completed.

Fracture Involving Crown and Root

Without Pulpal Involvement

In cases when the fracture line extends only about 2 mm apical to the marginal base level, healing occurs by PDL reattachment and cementum deposition on dentin. After administering local anesthesia and the tooth is isolated with rubberdam, fractured fragment is removed using a sharp scalpel to dissect it from the attached PDL. Bleeding is easily controlled with pressure or adrenaline. The exposed dentin is covered with CaOH_2 and temporary crown is placed with its margin covering the fracture line. Acid etch resin restoration can also be given when isolation can be adequately maintained. Approximately 2 months is needed for periodontal fiber reattachment.

Treatment outline of coronal fractures in vital teeth			
Type of fracture	Emergency phase	Intermediate phase	Permanent phase
CI I	Rounding of sharp edges	—	Cosmetic grinding, acid etch resin restoration
CI II	CaOH_2 protective layer reinforced by orthodontic band, stainless steel crown, celluloid crown form	Pin retained composite, cast $\frac{3}{4}$ crown, acrylic jacket crown.	Porcelain jacket crown or porcelain fused to metal crown
CI III	Pulp capping with orthodontic band, stainless steel crown or resin and celluloid crown form. Pulpotomy or pulpectomy with same as above extraction	Reinforced core and acrylic jacket crown RPD	Cast post and core, Porcelain jacket crown or porcelain fused to metal crown Fixed bridge

With Pulpal Involvement

Treatment options are:

In tooth with open apex

- Vital tooth = Pulpotomy, and post and crown restoration
- Non-vital tooth = Apexification followed by root canal treatment and post and crown restoration.

In tooth with closed apex:

- Vital or non-vital = Root canal treatment followed by post and crown restoration.

In a tooth with open apex, pulpotomy is the treatment of choice. The fractured fragment is kept in place if the fragment is attached, to act as a temporary restoration and maintain normal esthetics. Removal of the fragment may lead to bleeding, leading to difficulty in isolation. After apex closure is complete, root canal treatment is completed and tooth restored with post and crown.

In a tooth with closed apex, RCT followed by post and crown is recommended.



Fractured area must be exposed, so that the margins of the restoration are on solid tooth structure. This can be done by extrusion or periodontal crown lengthening procedure.

If the fracture includes more than 1/3 of the root then extraction is indicated.

Root Fracture

The fracture may be in the apical 1/3, middle 1/3, or coronal 1/3 of the root portion.

Transverse root fractures form 6% of all dental trauma. A steep occlusal radiograph (discloses fracture in apical 1/3 of the root) and IOPA (for identifying coronally located fracture) is recommended.

Factors important in the root fracture treatment are:

- Position of the tooth after fracture
- Mobility of the coronal segment
- Status of the pulp
- Position of the fracture line.

A tooth with root fracture and associated with a sinus tract or granulation tissue present across the fracture line is considered as non-vital. Revascularization and reinnervation of the damaged pulp are determined by the severity of the injury and by the healing capacity of the pulp, which is directly proportional to the stage of the root development.

Apical segment usually remains vital, thus treatment is rarely required and endodontic manipulation is confined to the coronal segment only. If apical segment becomes non-vital, surgical removal of the apical segment is necessary.

Healing of the root fracture: According to Andresen (1971), Healing Usually Occurs by:

- *Calcified tissue:* (Bridge of dentin and cementum) –healing occurs by calcified tissue when there is minimal amount of luxation, small amount of separation, young patient, immediate splinting and tooth without restorations or marginal periodontitis.
- *Interposition of connective tissue separating the 2 fragments:* It is associated with increased age of the patient, presence of restoration, orthodontic band splinting of the tooth and mild mobility.

- *Interposition of granulation tissue:* It is associated with existing infection, fracture line communicating with oral cavity, increased luxation, decreased fracture foramen, orthodontic band splinting and antibiotic therapy at the time of the injury.
- Interposition of bone and connective tissue.

Apical 1/3rd and middle 1/3rd fractures of the root:

In these fractures, there may be palatal displacement of the crown segment. The fragment is positioned under local anesthesia by digital pressure and stabilized by splinting. The tooth is observed radiographically and regular vitality test done. Endodontic treatment is instituted if the tooth becomes nonvital.

Apical 1/3rd fracture is treated by performing root canal treatment on the coronal portion and apical portion is removed surgically.

Middle 1/3rd fracture is treated by performing root canal treatment involving both the coronal and the apical fragments and obturated with silver point that also acts as a splint.

Coronal 1/3rd fractures of the root:

The tooth is positioned and immobilized by splinting. If healing is uneventful, no further treatment is needed. If there is pulp necrosis or failure to heal, endodontic treatment is done. Proximity of the fracture to gingival crevice makes pulpal infection more probable. Coronal portion can be removed, endodontic treatment completed on the apical fragment and restored with post and crown.

Orthodontic extrusion of remaining apical fragment may be necessary before performing root canal treatment to improve the situation, if the fracture line is deep and difficult to access.

Concussion

It includes injury to the supporting structures of the tooth without loosening or displacement, with significant reactions to percussion. It usually requires no treatment. Adjustment of occlusion with regular vitality test at subsequent visits (recall at 1 or 2 weeks after trauma and at 6 month interval for a minimum of 1year) may be adequate.

**Subluxation**

It is associated with abnormal loosening or mobility of the tooth but no displacement. There is often hemorrhage around the gingival margin of the tooth and the tooth may be sensitive to percussion. Treatment may be confined to selective grinding and adjusting the occlusion. If mobility is extensive and involves many teeth, the teeth are splinted using the acid etch splinting technique. Periodic reviews every 3-4 weeks are essential to monitor tooth vitality and periapical changes.

Intrusion

It is associated with significant damage to the PDL, resulting in a greater incidence of external root resorption. Most of the time the treatment involves allowing the tooth to re erupt.

Other methods of treatment are:

- Orthodontic extrusion and repositioning (requires about 3-4 weeks) followed by retention for about 8-12 weeks.
- Immediate surgical repositioning followed by splinting and endodontic therapy.

The tooth with incompletely formed roots have better prognosis.

Radiographically an intruded tooth will demonstrate an obliteration of the periodontal space. Periodic evaluation is done every 3-4 weeks for possible pulp degeneration.

Extrusion

The extruded tooth is repositioned by applying digital pressure in apical direction on the incisal edge. The tooth is then maintained in this position by splinting. Lacerated gingiva should be repositioned around the neck of the tooth and sutured. If there is no associated supporting bone fracture, period of stabilization is for 2-3 weeks, and with bone fracture, it is for 3-4 weeks to 6-8 weeks depending on the extent of bone fracture.

Lateral Luxation

It is associated with eccentric displacement of the tooth occurring in conjunction with some type of comminution or fracture of the alveolar socket. The tooth is

repositioned by applying digital pressure and splinted in the new position.

Avulsed Tooth

An avulsed permanent tooth can be reimplanted and stabilized. The prognosis following reimplantation depends on the amount of time the tooth was extraorally and the medium used for its storage during that period. It is thus very important to educate the parents and the teachers about the care of an avulsed permanent tooth.

Instruction given to patients or guardians following tooth avulsion:

- The tooth should be located and should be handled by holding the crown portion.
- Rinse gently under tapwater to clean the debris and not to scrub the tooth or use soap or other cleansing agents.
- To insert the tooth back after rinsing into the socket.
- The patient should gently occlude on a gauze or handkerchief for stability and should visit the dental office as soon as possible.
- If cannot be replanted, the tooth should be placed in suitable medium.

Media for storage of avulsed permanent tooth are: saliva, milk, blood, plain water, contact lens solution, cell culture medium, Hank's balanced salt solution (commercially available as Save-A-Tooth), or the tooth can be placed in the mouth between cheek and gums or under the tongue. The vitality of the cells can be maintained by wrapping the tooth in a clean wet handkerchief and placing it in a freezer. Soaking the root portion in fluoride solution has been found to reduce the chance of root resorption.

Features that may Improve the Prognosis of Replanted Permanent Teeth

- Maintenance of the periodontal ligament
- A short time between tooth loss and replantation
- Immaturity of the tooth to be replanted
- The undertaking of root canal therapy.

The treatment of choice for an avulsed tooth is reimplantation, if done within 30 minutes of injury. If stored in a suitable medium, it should be replanted within 1 hour.

**Storage media for avulsed permanent tooth:**

Water- least desirable due to its hypotonic environment that causes rapid cell lysis

Saliva-incompatible osmolality and pH and presence of bacteria. But allows storage upto 2 hours.

Milk-readily available, pH and osmolality is compatible to vital cells and relatively free of bacteria. Allows storage upto 3 hours.

Cell culture medium- good but not readily available
'Save-a-tooth'- contains Hanks balanced salt solution (HBSS)-could be made readily available in schools, play grounds, ambulances, etc.

Emergency Management of Avulsed Tooth

It is aimed at maintaining the attachment apparatus. Necrotic pulp is not of immediate concern because toxins are usually not present initially in a great enough concentration to elicit an inflammatory response. Endodontics is preferably not initiated at the emergency visit if the patient reports within 30 minutes. If the time lapse is more then it is preferred to perform an extraoral RCT, taking care not to damage the PDL fibers on the root surface.

Treatment Modalities of Avulsed Tooth***Extraoral Dry Time Less Than 30 Minutes with Closed Apex***

- A chance of PDL healing is excellent.
- Treatment includes cleaning the tooth off debris and rinsing followed by replantation and stabilization.
- Follow-up evaluation is done at regular visits.

Extraoral Dry Time Less Than 30 Minutes with Open Apex

- Revascularization of the pulp as well as continued root development is possible.

Extraoral Time of 30-60 Minutes with Either Open or Closed Apex

- Chances of revascularization is extremely poor, even in a tooth with open apex. Apexification procedure is initiated at the second visit if not done in the first.

- Root canal treatment is initiated at the second visit at 7-10 days in a tooth with closed apex.
- Treatment includes cleaning and replanting the tooth and accepting that the complications are inevitable.
- Studies reveal that soaking in storage medium can reduce ankylosis as there is increased chance of survival of cells. May be bacterial debris, necrotic debris, etc float off during soaking period (30 min).
- The tooth can be soaked in doxycycline (1mg of doxycycline mixed with 20 ml of physiologic saline) for 5 minutes before replantation for improving the revascularization significantly. Doxycycline inhibits bacteria, thus removing the major obstacle.

Extraoral Dry Time of >60 Minutes with Either Open or Closed Apex

- Soaking is ineffective as all the cells might have died.
- Here the aim is to make the root resistant to resorption.
- The tooth may be soaked in citric acid for 5 minutes, then in 2 % stannous fluoride for 5 minutes and then in doxycycline for 5 minutes before replanting it.
- Endodontics can be performed extraorally taking care to preserve the remaining PDL.

Following replantation: The tooth should be stabilized by acid etch composite resin splint. Rigid splinting for longer periods should be avoided to prevent post-replantation ankylosis or resorption, one week should be sufficient.

Laceration of the gingiva is sutured around the cervical area of the tooth. Endodontic treatment should be performed 1-2 weeks after reimplantation in the case of a closed apical foramen, when total pulp necrosis is anticipated as revascularization is not possible in an avulsed tooth with closed apex. When the apical foramen is wide open and reimplantation is done within a few hours after injury, endodontic treatment can be postponed to wait for possible revascularization of the pulp. Radiographs should be taken 1-2 weeks after reimplantation, because first evidence of root resorption is seen at this time.



Healing of Reimplanted Tooth

The tooth that is avulsed is associated with damage to the blood vessels and the PDL. The pulp may become necrotic.

Healing of replanted permanent teeth after accidental loss follows 3 courses:

1. Surface resorption of cementum
2. Replacement resorption
3. Inflammatory resorption.

Surface resorption of cementum: Healing occurs by repair with normal cementum deposition. If the trauma is mild it results in healing with the formation of new PDL and cemental layer. Histologically the repair of the resorption lacunae occurs with uninflamed PDL and cementum like tissue. It is symptomless and cannot be visualized on radiograph.

Replacement resorption: It is characterized by continuous replacement of root surface with bone, resulting in ankylosis. It usually follows extensive large area damage involving >20% of root surface. Initial inflammation is followed by removal of the debris and exposing the cementum. Cells start repopulating. Bone precursor cells will often move across from the socket wall and populate the damaged root rather than the slowly moving PDL cells. There is formation of bone directly in contact with root- called as dentoalveolar ankylosis. Osteoclasts that are also present resorb the dentin. Osteoblasts lay down bone in the area that was previously occupied by root. This progressive effect of ankylosis on an avulsed tooth is termed replacement resorption. Radiographically the distinction between the root and surrounding bone is lost and a moth eaten appearance results. Clinically, it presents with metallic sound on percussion and infraocclusion in the developing dentition.

Inflammatory resorption: This is characterized by development of bowl shaped areas of resorption of cementum and dentin associated with inflammatory changes consisting of granulation tissue with numerous lymphocytes, plasma cells and PMNL. Normally cementum prevents toxins from infected pulp reaching the PDL through dentinal tubules. After avulsion, the

cemental covering is damaged. If the pulp becomes necrotic, toxins pass through the dentinal tubules and stimulate inflammatory response in the corresponding PDL. The result is resorption of the root and bone called as inflammatory root resorption. This continues until the irritants are removed. Radiographically it is observed as progressive radiolucent areas of the root and adjacent bone. Seen as early as 2-3 weeks after avulsion. The treatment objective is to avoid or minimize effects of two complications, the attachment damage and pulpal infection by preventing drying of the tooth, elimination of toxins from the pulp and maintaining the integrity of the periodontal fibers.

Prosthetic replacement of avulsed tooth that cannot be replanted

A permanent anterior tooth, lost should be replaced with an esthetic appliance, which functions in speech and mastication and prevents tipping of adjacent teeth. In the young patient, a removable temporary appliance is constructed and worn until all permanent anterior teeth have erupted, alveolar changes have decreased and pulp chambers have receded to allow preparation for fixed replacements.

Postoperative Supportive Management

- Tetanus coverage
- Analgesics and antibiotics
- Chlorhexidine mouth wash for 7-10 days
- Management of swelling – application of ice, constricts the blood and lymph vessels.

A Traumatized Tooth is kept Under Observation

- Color change–Yellow - indicates calcific degeneration
Gray - indicates hemorrhage into dentinal tubules
- Mobility
- Periapical pathology
- Pain
- Swelling
- Parulis



Follow-up and Evaluation

Endodontic procedure if not done earlier should be initiated, at the first sign of pathosis. Calcium hydroxide can be used as temporary obturating material, until an intact periodontal ligament space is confirmed or if radiographic evidence of resorption is present. Calcium hydroxide is changed every 3 months. Ledermix can also be used.

Splinting of a Traumatized Tooth

The purpose of splinting is to stabilize the tooth in the arch in order to prevent further damage to the pulp and periodontal tissues.

Properties of an Ideal Splint

1. Should be quick and easy to fabricate
2. Should be atraumatic to the teeth and gingiva
3. Should be adequately stable throughout the healing period
4. Should have access to endodontic therapy if needed
5. Should be as esthetically pleasing as possible.

Different kinds of Splints Used

1. Wire and resin splint
2. Acid etch composite resin
3. Orthodontic brackets and wire splint
4. Interdental wiring
5. Full arch, vacuum molded acrylic splint
6. Sved type splint.

Wire and resin splint (Fig. 17.21): Round wire or rectangle wire used when 3-4 teeth are to be splinted. The wire is contoured to the arch and held in place by composite resin material. This splint is easy to fabricate and provides access for root canal therapy during splinting period.

Acid etch composite resin splint: It consists of a thick band of composite resin that extends on the labial surface of the teeth required to be stabilized and onto at least one tooth on either side of the traumatized tooth. This splint is strong, easy to fabricate, more esthetic and provides access for root canal therapy.

Orthodontic brackets and wire splint: The tooth to be splinted and the adjacent teeth on both the sides are



Fig. 17.21: Wire and Resin splint

fitted with brackets or bands. A 0.030"-0.036" orthodontic wire is adapted to the labial aspect of the bands. The wire is soldered or spot welded to the band.

Interdental wiring-Essig type splint: A 15 cm length 0.020 stainless steel wire is used to ligate an injured incisor tooth to the adjacent incisor teeth and canines. The wire is placed along the labial aspect of the anterior teeth. One end rests several millimeters beyond the distal surface of the canine. The other end is passed from labial to lingual through the interproximal space between the canine and adjacent bicuspid. This end is passed around the lingual aspect of the canine, into the mesial interproximal space and emerges under the labial wire. It is then bent over the labial wire and back to the lingual aspect through the same interproximal space. This is repeated for each anterior tooth until it passes between the cuspid and the first bicuspid in the adjacent quadrant. The free ends are twisted and trimmed and turned into the interproximal embrasure.

Full arch, vacuum molded acrylic splint: An impression is made and thermoplastic material is molded over the prepared cast. The borders are then trimmed and polished. One of the disadvantages of the full mouth acrylic splint is that an impression must be taken. This can dislodge the already loose tooth. To avoid this a tin foil can be placed on the crown, which may act as a temporary splint, and then the impressions may be taken.

Sved type splint: It is a type of removable splint fabricated in acrylic. It is constructed such that acrylic



extends over the occlusal or incisal surface of the tooth in question, thereby fixing and stabilizing the tooth.

Stabilization period:

After a traumatic injury any method of stabilization is contraindicated if it involves additional force or pressure.

Replanted tooth without root completion = 3-4 weeks

Replanted tooth with mature root formation = 1 week

Root fracture = 8-16 weeks

Subluxation = 2 weeks

Extrusion = 2-3 weeks

Intrusion = 6-8 weeks

Lateral luxation = 6-8 weeks.

REACTION OF THE PULP TO TRAUMA

1. *Pulpal hyperemia*: Even minor trauma is followed by pulpal hyperemia. Since collateral circulation is absent in the pulp hyperemic conditions may lead to infarction and pulpal necrosis. The tooth appears reddish and is often indicative of a poor prognosis.
2. *Internal hemorrhage*: Hyperemia and increased pressure may cause rupture of capillaries and the escape of RBC with subsequent breakdown and pigment formation. These may be reabsorbed before gaining access to dentinal tubules if bleeding is minute. In severe cases there is deposition of these pigments in the dentinal tubules. The change in color is evident within 2-3 weeks after injury and though is reversible, the crown may retain some amount of discoloration.
3. *Calcific metamorphosis of dental pulp*: There may be partial or complete obliteration of the pulp chamber or canal and the crown may appear yellowish opaque. Permanent tooth showing signs of calcific changes as a result of trauma should be regarded as a potential focus of infection and must be kept under observation or treated endodontically if possible.
4. *Internal resorption*: Appears as pink tooth. It is observed radiographically in the pulp chamber or

canal within a few weeks or months after injury. If the progression is rapid it may cause perforation of the crown or roots within a few weeks. Such teeth should be treated endodontically as soon as diagnosed.

5. *External root resorption*: It usually results due to the damage to the periodontal structures and the pulp may not be involved – seen in severe trauma in which there has been some degree of displacement of the tooth.
6. *Pulpal necrosis*: Any type of injury especially the displacement type may cause severance of the apical vessels. This lead to loss of vascular supply to the pulp leading to autolysis and necrosis. Injured teeth with subsequent pulpal necrosis are commonly asymptomatic and the radiograph is essentially normal. The acute symptoms and clinical evidence of infection will inevitably develop at a later date. Bacteriological status of the pulp tissue of root canal of intact but traumatized teeth reveals microorganisms, including anaerobic forms in the pulp canal of traumatized teeth. The source of microorganisms is through gingival sulcus or blood stream or both.
7. *Ankylosis*: It is caused by injury to the periodontal membrane and subsequent inflammation which is associated with invasion by osteoclastic cells resulting in irregularly resorbed areas on the peripheral root surface. The repair may occur by fusion of alveolar bone with root surface. Radiograph shows an interruption in the periodontal membrane of the ankylosed tooth and clinically appears submerged. Ankylosed anterior primary tooth must be removed to allow eruption of the permanent tooth.

Risk of pulp necrosis

Concussion – 2% chances of necrosis and pulp obliteration

Subluxation – 6-47% chances of pulp necrosis, 10-26% of canal obliteration, 4% of root resorption

Extrusion – 64% chances of pulp necrosis

Lateral luxation – 77% chances of pulp necrosis

Intrusive luxation – 100% chances of pulp necrosis and external root resorption



MANAGEMENT OF DISCOLORED TEETH

Treatment options include:

1. Bleaching
2. Veneering
3. Lamination.

Only bleaching is discussed in this chapter. Other methods are discussed in chapter 23.

Bleaching of Vital Teeth

Procedure

1. Prophylaxis with a rubber cup and unfluoridated pumice paste.
2. Lubricate the gingival tissue with petroleum jelly or topical anesthetic to prevent any tissue burning with the bleaching agent.
3. Isolate the teeth with an extra heavy rubber dam.
4. Saturate the cotton pellet with superoxol (30% hydrogen peroxide). Place the large cotton pellet on the tooth to be bleached.
5. Set the rheostat of heat source at 135°F: Apply heat to the moist pellet and ask the patient to raise the hand when the tooth begins to feel warm, then stop applying heat.
6. Repeat the procedure for each tooth. Treat each tooth on a rotating basis for 5 minutes at a time. Four or five 30 minute appointments are usually required to complete the procedure.
7. Remove the dam and check to determine whether any of the bleaching material has leaked through. A whitish appearing gingival tissue is an indication that leakage has occurred.

Bleaching of Non-vital Teeth

The primary indication for non-vital bleaching is to lighten the teeth that have undergone discoloration after root canal therapy. Discoloration in a nonvital teeth is due to the disintegration of the by products of blood namely the hemosiderin and hematin from the pulp, or due to the restorative material left in the pulp chamber.

Non-vital bleaching are of two types, the in-office thermocatalytic and the walking bleach. Walking bleach

is preferred due to increased risk of cervical resorption associated with in-office bleach which is due to the application of heat.

In Office Bleaching Technique

35% hydrogen peroxide is placed into the debrided and sealed pulp chamber and the oxidation process is accelerated by placement of a heated instrument into the pulp chamber. Recent modification is the use of pastes and gels that do not require heat application.

Walking Bleach

Following root canal obturation, the gutta percha is sealed with polycarboxylate cement. A mixture of sodium perborate and 30% hydrogen peroxide (superoxol) is placed in the pulp chamber and a temporary restoration is placed over the mixture. 7 days later the tooth is examined for color change. If required second or third procedure may be required. It is advisable to over bleach by one or two shades as there is tendency for the color to regress.

The patient and the parent should be priorly informed that there may be little or no improvement in the color of the teeth following bleaching or that within 6 months the discoloration may begin to reappear

EFFECTS OF TRAUMA ON DEVELOPMENT OF SUCCEDANEOUS TEETH

The roots of the deciduous incisor teeth lie just labial to the tooth germs of the permanent incisor teeth, which makes them susceptible to the pathological process as a result of trauma or the sequelae of trauma to deciduous teeth. The prevalence of disturbances to the permanent teeth as a result of trauma to the primary teeth ranges from 13-57%, and is dependent on the type and severity of the trauma, stage of permanent tooth development and the mode of treatment of the injury itself.

- *White or yellow brown discoloration of enamel:* Usually seen on the labial surface of the tooth. There is usually no clinically detected defects in the enamel. These are common lesions accounting for 23% of the developmental disturbances. Yellow discoloration



is due to the result of breakdown products of hemoglobin from bleeding in the area at the time of injury.

- *White or yellow brown discoloration of enamel and horizontal enamel hypoplasia:* Enamel defects here is similar to the discoloration mentioned in the previous defect. In addition a narrow horizontal indentation encircles the crown cervical to the discolored area. Usually seen when the injury occurs at about 2 years of age. It accounts for about 12% of the defects and is usually associated with avulsion or intrusion of the primary tooth. The defect is probably due to localized arrest of the enamel matrix formation that occurs due to injury to ameloblasts by slight axial displacement of the tooth within its crypt.
- *Change in the position of the developing tooth bud (Fig.17.22):* The change in tooth bud position can be in a horizontal or a vertical direction.
- *Crown dilaceration:* Occurred in 25% of the cases. The crown is usually displaced in a palatal direction for the maxillary teeth and in the opposite direction for the mandibular teeth. This injury is usually associated with intrusion and avulsion of the deciduous tooth.
- *Odontome like malformation:* It appears as conglomerate hard tissue having the morphology of a complex odontome, seen in 6% of the cases. It is usually the result of an intrusion or avulsion and occurs when one fourth or less of the crown has been formed.
- *Root duplication:* It is very rare and is due to division of the root into a mesial and distal portion, when the injury occurs at 2 years or less at the time when the crown is half or less developed.
- *Vestibular root angulation:* It consists of marked labial curvature of the root portion of the tooth. This injury occurs at 2-5 years of age and is usually the result of intrusion or avulsion.
- *Lateral root angulation or dilaceration:* It appears as a mesial or distal bending, confined to the root portion of the affected tooth. This lesion is usually the result of an avulsion.
- *Partial or complete arrest of root formation:* In spite of cessation of development, the teeth usually erupt into normal position.
- *Sequestration of the entire tooth germ:* It is an extremely rare injury.
- *Eruption disturbances:* Permanent successors can be impacted, delayed or accelerated in their eruption as a result of injuries sustained to deciduous teeth.

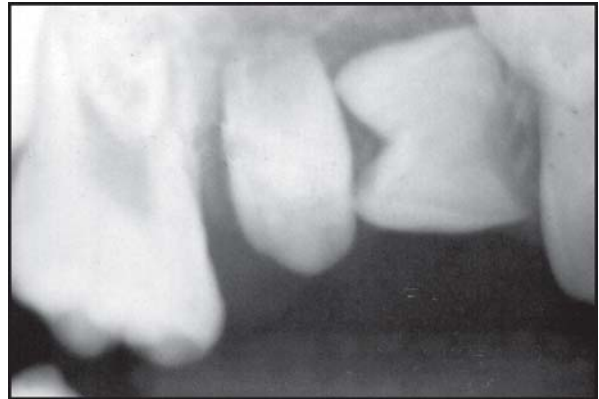


Fig. 17.22: Displacement of the developing first premolar following trauma and avulsion of the deciduous first molar

PREVENTION OF TRAUMA DURING CONTACT SPORTS

- Orthodontic correction of the trauma prone profile
- Use of mouth protectors or mouth protectors.

Mouth Protectors

They are intraoral device used for protecting the teeth during contact sports to protect. They were originally made of clear, transparent material. Most of the football associations makes it mandatory, that a coloured mouth guards be used for easy detection to note whether players are wearing them or not and for easy retrieval if lost. Newer styles are composed of thermoplastics boiled in water and then inserted into the mouth and are custom fit.

Ideal Requirement of a Mouth Protector

1. Should be of adequate thickness to reduce impact of trauma on the tooth.
2. It should have good fit and should not fall off from the mouth during the activity nor be very tight.



3. Should not interfere with speech and breathing.
4. Material used must be non-allergic.

Classification of Mouth Protectors

1. Type 1 – Stock types
2. Type 2 – Mouth formed
3. Type 3 – Custom fabricated.

Type 1 – Stock types: They are preformed mouth protectors and is inexpensive. They have poor retention and is held together by clenching the teeth.

Type 2 – Mouth formed: They are of two types, thermoplastic and shell lined mouth guard. The thermoplastic type is boiled and adapted inside the mouth by biting close the teeth. In case of shell lined mouth guard, a liner is added at the borders of the appliance to improve its fit and allowed to harden inside the mouth. The liner used is ethylmethacrylate. This liner is changed before wearing to improve the fit of the device. The main disadvantage is the bitter taste of the fresh liner and extra work and time needed before each game.

Type 3 – Custom fabricated: It is fabricated on the individual's cast using material like poly vinyl acetate-Polyethylene. It exhibits the best fit and comfort.

Instructions to the Patient

1. Clean the mouth guard by washing it with soap and cold water before and after use.
2. Preferably dip the mouth guard in mouthwash before storing or usage.
3. Keep it securely in a box with ventilation holes so that the temperature inside the box should not increase.
4. Do not place mouth guards out side in the sun or near a oven or a fire place.
5. Do not allow others to wear your mouth guard.

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Chapter 18



Child Abuse and Management

1. Introduction
2. Definition
3. Types of abuse and neglect
 - Physical abuse
 - Sexual abuse
 - Physical neglect
 - Emotional abuse and neglect
 - Failure to thrive
 - Intentional poisoning/drugging
 - Munchausen's syndrome by proxy
 - Health care neglect
 - Safety neglect
 - Educational abuse
4. Injuries associated with abuse
5. The characteristics of an abused child
6. Role of dental surgeon



INTRODUCTION

Child abuse and neglect is an international problem having victims of all ages, races, religions and socioeconomic background. Formerly called battered child syndrome, child abuse and neglect have been recently described as non-accidental injury (NAI).

DEFINITION

Child abuse and neglect (CAN) is defined “as any interaction or lack of interaction between a care giver and a child resulting in non-accidental harm to the child’s physical or developmental state”.

Battery is a term often associated with abuse, defined as an “unprivileged touching of another person’s body”.

Henry Kempe in 1962 first reported the term “battered child syndrome”. According to him, a child exhibiting the following features should be included under this syndrome.

1. Evidence of fracture of long bones
2. Subdural hematoma
3. Failure to thrive
4. Soft tissue swelling or skin bruising.

TYPES OF ABUSE AND NEGLECT

1. Physical abuse
2. Sexual abuse
3. Physical neglect
4. Emotional abuse and neglect
5. Failure to thrive
6. Intentional poisoning/drugging
7. Munchausen’s syndrome by proxy
8. Health care neglect
9. Safety neglect
10. Educational abuse.

Physical Abuse

- It forms 60% of the child abuse related fatalities.
- It is a non-accidental means of trauma to the body of the child, which may result in severe injury or even death.

- These type of injuries may be inflicted by the parents, relatives or baby sitters.
- Incidence of physical abuse is more in families of low socioeconomic status.
- Abusers are most of the time unhappy, angry adults under stress. They injure their children in anger for some misbehavior to relieve their frustration.

The injuries sustained may vary from mild such as few bruises, scratches, etc to severe ones such as burns, CNS injury, abdominal injury, multiple fractures or other life threatening injuries.

Evidence for suspecting physical abuse

1. Injury unusual for a specific age group (e.g. fracture in an infant)
2. History of previous/recurrent injury
3. Unexplained injury
4. Bruising in unusual areas with bruising patterns (buckle marks, etc.)

Sexual Abuse

The national center on child abuse and neglect defines sexual abuse “to include contacts or interactions between a child and an adult”.

Evidence for suspecting sexual abuse are:

- A. Report by the patient or gaurdian
- B. Early and exaggerated awareness by the patient about sex.
- C. Physical trauma, if present, tearing, bruising or specific infection of the mouth, anus or genitals
- D. Pregnancy.

Physical Neglect

It consists of failure to provide the basic necessities such as adequate food, shelter, clothing and also health care needs.

Physically neglected children tend to exhibit at least several of these characteristics.

- A. Dirty clothing and skin with foul smell, lice and unkempt appearance.
- B. Undernourished.
- C. Rampant caries, abscess, periodontal lesions, etc.



- D. Uncared wounds.
- E. Constant sleepiness or hunger.
- F. Failure maintain appointments.

The reason for neglect may be parent's illness, poverty, ignorance, unusual stress on the family.

Emotional Abuse and Neglect

The child is emotionally attacked by parents, teachers or any caretakers. The child is harassed verbally and made to feel low either by direct abuse or by ridiculing the child in front of others. Severe forms may take the form of locking the child in a dark room.

Failure to Thrive

Some parents may not take care of the newborn and thus the child may be malnourished and underweighed. Common reason for such behavior is that the mother does not like or want the baby. Other reasons may include depressed mother, recent separation of the parents, etc.

Intentional Poisoning/Drugging

It is an uncommon lethal type of child abuse, involving administration of a harmful drug that is not intended to be used by the child. Parents who poison their children may have severe marital problems or may be drug abusers.

Munchausen's Syndrome by Proxy

Parents fabricate or induce illness and subject the child to unnecessary medical investigation, hospital admissions and treatment. Children are usually less than 6 years of age and too young to understand the deception. Parents may administer laxatives and complain to the doctors that their child is suffering from diarrhea.

Health Care Neglect

Parents ignore or do not provide the necessary medical or dental treatment to the child even until the condition proceeds to a serious or irreversible extent.

Safety Neglect

Includes gross lack of direct or indirect supervision of a child that results in an injury.

Educational Abuse

Parents do not educate their children or are not bothered about the chronic absenteeism of the child from school. They may intentionally keeps the child at home and do not allow him or her to attend school.

INJURIES ASSOCIATED WITH ABUSE

Orofacial Injuries (Figs 18.1 to 18.3)

- Parents hit the child on the mouth or lip to silence a crying child leading to injuries on the lip or adjoining area.
- Hitting hard on the face over the eyes can lead to subcutaneous hemorrhage around the eyes or any kind of injury depending on the device used to hit.
- Slapping leads to bruises on cheek, which— due to slap - where 2 or 3 parallel lines marking the finger marks may be seen.



Fig. 18.1: Injury to the left eye caused due to the child being pushed onto the wall



Fig. 18.2: Injury to the right eye by a blunt device



Fig. 18.3: Scratch injury on the cheek due to hitting the child's face with a pen

Injury to Skin and Subcutaneous Tissues

- Marks seen on the skin are commonly due to holding the child's hand tightly or due to rope or cloth used for restraining. Marks can also be seen when hit with an object.
- Burn injuries caused by cigarette buds or hot objects are common and the shape of the injury resembles that of the object used. Burn injuries due to hot water produces blisters or scalds over the area of injury.
- Bite marks are seen as elliptic or ovoid pattern formed by the upper and lower teeth on the skin.

Head Injuries

- Such injuries are seen in cases of severe cases of abuse.
- Injuries include subdural hematoma, subarachnoid hemorrhage, etc.

Bone Injuries

- Fractures are also associated with severe cases of abuse.
- Fractures of the ribs, upper and lower limb is seen.

Abdominal Injuries

- Caused by punch and kicks that compress the organs against the spinal column and forms the second most common cause of death in cases of abuse.
- Bruises or ruptured viscera – may result in massive hemorrhage – shock and death.

THE CHARACTERISTICS OF AN ABUSED CHILD

The child often has characteristics that make him / her provocative, such as negativism or a difficult temperament. Some of the more offensive misbehaviours are intractable crying, wetting, soiling and spilling.

The abuser describes the abused child as difficult to control, bad or selfish. Children are most of the time passive, afraid and presents with repeated skin or other injuries.

Features of Abused Child

1. Unduly afraid or passive
2. Evidence of prolonged confinement
3. Evidence of repeated skin or other injuries
4. Inappropriate treatment of injuries by parents.
5. Undernourished child
6. Inappropriate dressing
7. May be aggressive, demanding or hyperactive or cranky, irritable or cries easily.

The Abuser

Child abuse occurs in all cultural, occupational, socio-economic and ethnic groups. A proportionately higher incidence of abuse is reported in minority and low income family.

Father, mother or caretaker may be the abusers. The parents may have the following characteristics indicative of abusive behavior.

1. Poor self esteem and coping skills.
2. Violent tempers or outbursts.
3. Unrealistic expectation of child's behavior.
4. Inappropriate response to the seriousness of the child's condition.



5. Over critical behavior toward the child.
6. Avoidance of looking at or touching the child.
7. Reluctance to give the history of the accident or giving an unrealistic explanation.
8. Request for treatment long after injury has occurred.
9. Appearance of confusion or embarrassment when discussing the child's trauma.
10. Immature, depressed or demanding.

ROLE OF DENTAL SURGEON

Dental surgeons are in a unique position of seeing patients that are victims of abuse and neglect. More than 50% of the abuse occurs to the head and facial area.

Often the first medical professional to see these children routinely is a dentist. The ability to recognize the signs and symptoms when such an incident presents itself can make a difference in the child's physical, emotional and social well being and may even save a child's life.

A dental surgeon has 3 main responsibilities towards abused children.

1. Detection
2. Reporting
3. Prevention.

Numerous dentists fail to report suspected abuse and neglect, which may be due to:

- A. Lack of knowledge to identify
- B. Do not know where to report such cases
- C. Thinking "it is not our responsibility".

The usual controversy which exists among dental surgeons is whether they should inform the parents or caretakers that they have reported the case. The Law Enforcement Agencies stress that the parent or caretaker should not be told because of their concern for the protection of the child. If the alleged perpetrator is a member of the family, talking to the family may cause the child to suffer additional abuse or the family may move and the abuse will no doubt continue.

Once a dental surgeon is suspicious that an injury or lesion is of non-accidental origin, the findings must be collected permanently and accurately documented and presented in the court. The records must be in the

form of photographs, written documents, radiographs and diagnostic study casts.

Examination

It includes obtaining a general impression as to the child's overall cleanliness, size and stature, interactions with the parent or caretaker and gait. A complete and thorough examination of the craniofacial area is essential, since these exposed areas are often involved in physical abuse.

Careful examination of the cranium and scalp can reveal battering lesions. Common findings include traumatic alopecia. Others being presence of lice, abnormalities of the ear, periorbital ecchymosis, scleral hemorrhage, ptosis, deviated gaze or unequal pupils, blood clots of the nose or presence of DNS (Deviated Nasal Septum).

Diagnosis

The evidence of physical abuse is generally easily recognized. There are types and sites of injury so common in child abuse that merely finding them is diagnostic. For example A child learning to walk may sustain injuries to shin, elbow, hands and forehead. But injuries to buttocks, lower back, genitals, inner thighs, etc. raise serious questions of non-accidental trauma. In addition, injuries to the cheeks, ears, upper lip, frenum, chest or abdomen should always be questioned.

The first step in diagnosis is taking a good history. A child's statement that some one caused an injury is usually accurate. If one parent accuses the other of inflicting the trauma on the child, even this can be taken as eyewitness account unless the child is involved in custody battle. A partial confession such as admitting to only part of or one of the multiple injuries, can be just as diagnostic as a complete confession.

It is highly suspicious when a parent is unaware or he is unable to explain an obvious injury, because most nonabusive parents know precisely how or when an injury occurred and are willing to discuss it.

Prognosis

If abused children returned to their parents without any intervention about 5% will be killed or 25% seriously injured.



Children with repeated injuries to the CNS may develop mental retardation, organic brain syndromes, etc. Common emotional traits of abused children are fearfulness, aggression and hyperactivity or may turn out into next generation of child abusers.

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Chapter 19



Dental Management of Handicapped Children

1. Definitions
2. Classification of Handicapping Conditions
3. Dental Management of Various Handicapping Conditions Such As
 - Cerebral palsy
 - Mental retardation
 - Congenital cardiac disease
 - Cleft lip and palate
 - Down's syndrome
 - Renal diseases
 - Liver disease
 - Diabetes mellitus
 - Hypopituitarism
 - Hyperpituitarism
 - Hypothyroidism
 - Hyperthyroidism
 - Hypoparathyroidism
 - Hyperparathyroidism
 - Respiratory disease (asthma)
 - Immunodeficiency
 - Epilepsy
 - Childhood autism
 - Blindness
 - Deafness
 - Bleeding disorder
 - Coagulation disorders
 - Hemophilia A
 - Sickle cell anemia
 - Thalassemia
 - Leukemia
 - Organ transplantation
 - Bone marrow transplantation
 - Children on anticoagulants
4. Dental Office Access
5. Physical Restraints for Handicapped Child
6. First Dental Visit of a Handicapped Child
7. The Different Responses Exhibited by Handicapped Child
8. Radiographic Examination
9. Preventive Methodologies



DEFINITION

Medically compromised child is the term used to describe children who are suffering from any type of medical ailment which can be of a short or long duration. The extent of the disability depends on the severity of the disease.

WHO defines a handicapped individual as “One who, over an appreciable time, is prevented by physical or mental condition from full participation in the normal activities of his age group, including those of a social, recreational, educational, and vocational nature”.

American Public Health Association defines handicapped child as:

“A child who cannot within limits play, learn, work or do things other children of his age can do; he is hindered in achieving his full physical, mental and social potentialities”.

Definitions of other terms are:

Defect—“Some imperfection or disorder of the body, intellect or personality”.

Disability—“Defect which does result in some malfunctioning but which does not necessarily affect the individual’s normal life”.

Handicap—“Disability which, for a substantial period or permanently, retards, distorts or otherwise adversely affects growth, development or adjustment to life”.

The comprehensive care required by these persons is time consuming and many patients as well as their families are uncooperative. The dentist, who extends his responsibility beyond the treatment of the ‘chief complaint’ however, will find great rewards in helping the disabled patient and his family adjust to and deal effectively with a long-term disability.

CLASSIFICATION OF HANDICAPPING CONDITIONS

I. Nowak has divided handicapping conditions into 9 categories:

- | | |
|-----------------------|-------------------------------|
| 1. Physical | a. Cerebral palsy |
| 2. Mental retardation | |
| 3. Congenital defects | a. Congenital cardiac disease |

- | |
|-------------------------------------|
| b. Cleft lip and palate |
| c. Down’s syndrome |
| 4. Metabolic and systemic disorders |
| a. Renal diseases and liver disease |
| b. Diabetes mellitus |
| c. Hypo/hyperpituitarism |
| d. Hypo/hyperthyroidism |
| e. Hypo/hyperparathyroidism |
| f. Respiratory disorders |
| g. Immunological disorders |
| 5. Convulsive disorders |
| 6. Childhood autism |
| 7. Blindness and deafness |
| 8. Hematological disorders |
| 9. Neoplasias. |

II. Handicapping conditions have been divided into intrinsic and extrinsic categories:

- Intrinsic—“one from which the person cannot be separated”, e.g. all the medical and physical disability.
- Extrinsic—“one from which the person can be removed”, e.g. social deprivation.

III. Handicapping conditions can be:

- Mental handicap
- Physical handicap
- Medical handicap.

Cerebral Palsy

It is characterized by paralysis, weakness, incoordination or other aberrations of motor function and have their origin either prenatally or postnatally before the CNS has reached maturity, i.e. at the age of 5 years. It may be seen in conjunction with other manifestations like seizures, mental retardation, etc. The cause may be due to congenital defects, chemical or mechanical or infections.

Definition

‘Nelson’ described cerebral palsy as a group of non-progressive disorders resulting from malfunction of the motor centers and pathways of the brain.



Incidence

Approximately 0.6-5.9 per 1000 births.

Classification

Cerebral palsy can be 5 types, they are:

- A. Spasticity
- B. Athetosis
- C. Ataxia
- D. Rigidity
- E. Tremors.

Spasticity:

- Occurs in > 40% of the cases
- Caused due to lesion in the cerebral cortex
- Flexion deformities are seen which are due to tendency for the antigravity muscles to maintain a state of contraction and for the antagonists to lengthen
- Usually associated with convulsions and mental retardation
- Head movement is limited
- Hypertonicity of facial muscles and slow jaw movements
- Hypertonic orbicularis muscles
- Associated with spastic tongue thrust and drooling
- Constricted mandibular and maxillary arches
- Class II division 2 malocclusion with unilateral cross bite.

Athetosis:

- Occurs in about 25% of the cases
- Caused due to a lesion in the basal ganglion
- Muscles are normal, there is no spasticity or weakness
- Involuntary movements, either tremor or rotary may be seen
- Usually associated with convulsions and mental retardation
- Excessive head movement or head drawn back with bull type neck
- Quick jaw movements with bruxism
- Hypotonic orbicularis muscles
- Grimacing and drooling
- Tongue protrudes out
- High and narrow palatal vault

- Class II division 1 malocclusion
- Presence of anterior open bite and associated with mouth breathing
- Poor swallowing, sucking, etc. due to impaired function of muscles of deglutition.

Ataxia:

- Occurs in 10% of cerebral palsy patients
- Caused due to lesion of the cerebellum
- Disturbances in equilibrium is present
- No abnormal muscular involvement
- Lack of positional sensation (balance)
- Poor proprioceptive sensations
- Slow tremor like head movements
- Hypotonic orbicularis muscles
- Ankyloglossia in some cases is seen
- Associated with tongue protrusion and open bite
- Grimacing and drooling.

Rigidity:

- Occurs in 5% of the cases
- Caused due to lesion of the basal ganglion
- Constant rigidity of muscles seen
- Voluntary movements are slow and stiff
- Adequate mouth opening may be difficult.

Tremors

- Present in about 5% of the cases
- Caused due to lesion in the basal ganglion
- Features are—repetitive, rhythmic involuntary contraction of flexor and extensor muscles.

General disabilities associated with cerebral palsy are:

- Speech defects—50-75%
- Mental retardation—45%
- Visual defects—20-50%
- Seizures—35-60%
- Deafness—10-30%

Dental Consideration and Management

- No specific oral disease is related to cerebral palsy.
- Usual dental problems of caries and periodontal disease are often exaggerated by neglect.
- There is no significant difference in the eruption time of primary and permanent teeth.



- Routine procedures can be accomplished.
- Generally they will understand and cooperate when the dentist explains before starting a procedure, unless severely mentally retarded.
- Physical restraints can be used to control abnormal movements of head, body and the extremities.
- The dentist should at all times support or cradle the patients head to control involuntary movements.
- Premedication is very useful, but the dentist should be thorough with the patients medications and their probable interactions with each other.
- Gag, cough, bite and swallowing reflexes may be impaired or abnormal. If the Gag reflex is more exaggerated, patient should be seated in an upright position.
- Rubber dam should be used, due to increased chance of aspiration.

Communication

It forms an important aspect in the management of patients with cerebral palsy. Significant personality differences exist in each type of cerebral palsy and thus communication with the patient can be more easily attained by understanding the characteristics of each.

Behavior in Dental Clinic

Spastic patient:

- Shut and introvert
- Fearful and spastic episodes may be induced by any outside stimulus, e.g. loud noises, sudden movements or even meeting strangers
- They prefer an environment devoid of excitement and stimulation.

Rigid:

- Similar to spastic patient in personality
- Fear generally is not so pronounced.

Athetosis:

- Without excessive fear
- Provoked to outbursts of anger
- Craves attention, affection and enjoy people's company.

Ataxic:

- Resembles athetoid patient
- Has little fear
- When asked to make repeated efforts he gives up quickly.

Mental Retardation

For a person to be diagnosed as mentally retarded, he should possess all the below mentioned three characteristics:

1. An IQ score of less than 70
2. An accompanying impairment in adaptive behavior
3. A manifestation of both before 18 years of age.

Definition

The American Association of Mental Deficiency (AAMD) has defined it as follows:

“Subaverage general intellectual functioning which originates during the developmental period and is associated with impairment in adaptive behavior”.

Incidence

About 0.5% of the preschool children are recognized as being retarded. The peak period of recognition is between 6-16 years, when the pressures of formal schooling seem to identify a larger number. The incidence may reach 10% or more of the school population in some areas.

Classification

The AAMD classifies retardation in 4 categories.

1. Mildly or educable mental retardation (EMR), IQ of 69-55—the educational programs are generally simplified versions of regular school programs and usually lead to literacy and attainment of skills necessary for employment. They form about 80% of the total cases.

Etiology of mental retardation

Prenatal cause:

- Genetic diseases
- Maternal and fetal infections



- Kernicterus
- Cretinism
- Fetal alcohol syndrome

Natal cause:

- Birth injuries
- Infection
- Cerebral trauma
- Hemorrhage
- Hypoxia
- Anoxia
- Hypoglycemia

Postnatal cause:

- Cerebral infections
- Cerebral trauma
- Poisoning
- Cerebral vascular accidents
- Postimmunization encephalopathy
- Malnutrition

2. Moderately or trainable mental retardation (TMR), IQ of 54-40.
3. Severely retarded, IQ of 39-25—(non-trainable).
4. Profoundly retarded, IQ of <25—(non-trainable).

Dental Considerations

The oral cavity is generally not the primary area of concern to the patient or the family and also the patient is very uncooperative to maintain good oral hygiene. The result is poor oral health. The ideal approach is to start the patient on a good oral hygiene and preventive program and then restore the dentition.

- Premedication can be extremely helpful in allaying the anxiety.
- First visit should be limited to oral examination, oral radiographs or oral prophylaxis with fluoride application. The time taken for a procedure may vary depending on the extent of cooperation and is generally slower and requiring some modification such as the use of tongue blades, mouth props, and assistance to restrain the child.
- Radiographs are difficult to take due to gagging and uncooperation. Film holders can be used.

Modifications in Treatment Plan

- A. Strong restorations such as steel crowns are preferred to large amalgam restorations.
- B. Pulpotomy or preferably pulpectomy therapy should be accomplished rather than less reliable pulp capping procedure.
- C. Resorbable sutures should be used after surgery.
- D. It is advisable to attach floss to instruments such as files, reamers, stainless steel crown (after welding a small loop to the buccal surface) etc.

Congenital Cardiac Disease

Children with this disorder represent one of the largest groups of medically compromised patients.

Clinical features

1. Clubbing of the fingers
2. Cyanosis of mucosa
3. Shortness of breath

Features and Dental Importance

- Risk of infective endocarditis is present, hence antibiotic prophylaxis should be given prior to any invasive procedure.
- Preoperative oral antiseptic mouthwash—0.2% chlorhexidine gluconate is ideal.
- Increased bleeding tendency may be present.
- Increased prevalence of enamel hypoplasia and dental caries in the primary dentition.
- Pulpotomy is contraindicated due to the possibility of subsequent bacteremia.
- There are no contraindications for the use of Lignocaine 2% and adrenaline 1: 100,000.
- Treatment under general anesthesia should be performed in hospital only.
- Sedation can be given to the patient but under careful monitoring.
- Patients with pacemakers should be identified and all dental device that may interfere with the



pacemaker such as electrosurgical units, pulp testers, ultrasonic cleaning device etc. should be disconnected.

Dental procedures requiring prophylaxis in a patient suffering from congenital cardiac disease

Prophylaxis recommended	Prophylaxis not recommended
- Dental extractions and other surgery - Periodontal procedures including prophylaxis, subgingival procedures and probing, if bleeding is anticipated - Dental implant placement, reimplantation of avulsed teeth - Endodontic procedures - Initial placement of orthodontic bands - Intraligamentary anesthesia	- Restorative dental treatment, if bleeding is not anticipated - Intracanal endodontic obturation or post placement - Placement of rubber dam - Suture removal - Oral impressions - Fluoride treatment - Intraoral radiographs - Shedding of primary teeth

Guidelines for infective endocarditis antibiotic prophylaxis

Oral route	Amoxicillin	Adults—2.0 gm Children—50 mg/kg —one hour before procedure
Unable to take oral medications	Ampicillin	Adults—2.0 gm Children—50 mg/kg, (IM or IV) —30 minutes before procedure
Allergy to penicillin	Clindamycin	Adults—600 mg Children—20 mg/kg, peroral —1 hour before procedure
	Cephalexin or Cefadroxil—1 hour before procedure	Adults—2.0 gm Children—50 mg/kg, peroral
	Azithromycin/Adults—500 mg	Children—15 mg/kg
	Clarithromycin	—1 hour before procedure
Allergic to penicillin and unable to take oral medication	Clindamycin	Adults—600 mg Children—20 mg/kg, IV —30 minutes before procedure
	Cefazolin	Adults—1.0 gm Children—25 mg/kg, IM or IV —30 minutes before procedure

Cleft Lip and Palate

The oral cavity is bounded anteriorly by the upper and lower lip and posteriorly extends upto the oropharynx. The roof is formed by the palate and floor by the structures in the floor of the mouth. Laterally it is bounded by the cheeks.

The lower lip is formed by the fusion of mandibular process in the midline and the upper lip is formed as

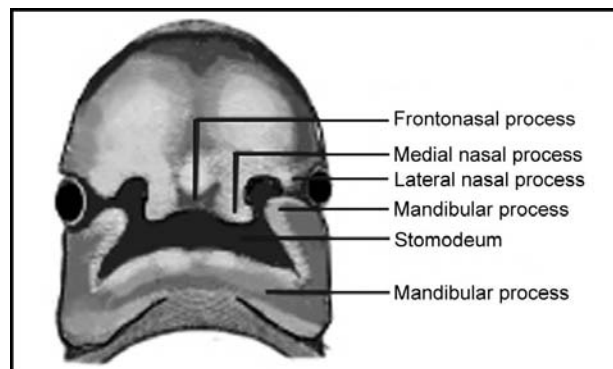


Fig. 19.1: Development of face and associated structures occur by the fusion of different processes

the maxillary processes grow medially and fuse with the lateral nasal and the medial nasal processes (Fig. 19.1). The lateral and medial nasal process fuses with each other to form the anterior nares. As growth occurs the frontonasal process becomes narrower from side to side.

The palate is formed by the fusion of the two lateral maxillary palatal shelves and the caudal portion of the frontonasal process. Initially these three processes are widely separated from each other due to vertical orientation of the lateral maxillary shelves and the developing tongue occupies this space. The primary palate includes a wedge shaped area in front of the incisive fossa and carries 4 tooth buds.

During 6th week of intrauterine life, a shelf like projection of palatine process grows medially from each maxillary process. The presence of the developing tongue prevents the palatine process from meeting each other. So they grow caudally along the side of the developing tongue.

During 7th week the mandibular arches grows more caudally and ventrally producing prominence of chin.

During the 8th week as the tongue moves downward and forward along with the developing mandible, the palatal shelves change from a vertical to horizontal position contacting each other in the midline and also with the premaxilla in the anterior region.

The fusion of 3 palatal components initially forms a 'Y' shaped suture. The site of fusion of lateral palatal shelves is traced in adults by the mid palatal suture. Ossification starts during the 8th week of IU life from



the spread of bone into the mesenchyme of the fused palatal shelves and laterally spreading to the premaxilla. Mid palatal suture is first evident at 10½ week. Ossification does not occur in the most posterior part of the palate, which gives rise to soft palate.

Mechanism of Cleft Formation

- A. Failure of mesoderm to unite—as the lateral growth of the face was more
- B. Deficient mesoderm
- C. Insufficient migration potential of mesoderm
Failure of tongue to move downward, leads to failure of palatal shift or abnormally large tongue.

Etiology for Cleft Formation

Hereditary: If both the parents are normal, there is 4% chance and if one parent is having cleft then there is 12% chance and 45% if both of them are affected. Cleft lip and palate has a multifactorial inheritance pattern, that is, even though a susceptible gene is present it also requires exposure to adverse environmental factors conducive to cleft formation.

Environmental factors:

- Riboflavin deficiency (Riboflavin is necessary for organogenesis)
- Radiation may cause chromosomal aberration
- Antimetabolites—block enzymes which interfere with DNA synthesis
- Hypoxia—may give rise to vascular deficiency
- Cortisone—inhibits palatal shelf elevation
 - reduces amniotic fluid
 - reduces RNA synthesis
- Inhibition of mitosis
- Tolbutamide—decreases uptake of glucose
- Oligohydramnios (reduced amniotic fluid) – causes hyperflexion of the head fold resulting in micrognathia. The small jaw pushes the tongue up between the palatal shelves.

Epidemiology

- Incidence: Cleft lip with palate—highest incidence is 45%

Cleft palate—30%

Cleft lip—25%

- **Race:** Negroes are affected the least and Japanese most frequently
- **Sex:** Cleft lip is higher among males but cleft palate is common in females
- **Parental age:** increase in frequency of cleft lip with or without cleft palate with increasing parental age is seen.
- **Associated malformations:** A number of studies have shown that in individuals born with cleft lip and or palate there is increased likelihood of other congenital malformation. 10-20% have other congenital abnormalities like defects of extremities and congenital heart diseases. Syndromes associated with cleft palate are—cleidocranial dysostosis, craniofacial dysostosis, Pierre Robin syndrome, Marfan's syndrome.

Classification of Cleft Lip and Palate

There are various classification systems available:

1. Morphologic classification – a. Davis and Ritchie
b. Veau's—palate—lip
2. Embryologic classification—Fogh and Andersons
3. Symbolic classification—Kernahans striped 'Y'
4. Kernahan and Starte's classification.

Davis and Ritchie	
Code	Location
Group 1 (Pre-alveolar cleft)	Lip—unilateral, median, bilateral
Group 2 (Post-alveolar cleft)	Soft and hard palate—various degree of involvement up to the alveolar ridge
Group 3 (Alveolar cleft)	Palate, alveolus and lip—unilateral, median and bilateral

Veau's—Classification of palate	
Code	Location and type of defect
Group 1	Palate—soft
Group 2	Palate—soft, hard upto incisive foramen
Group 3	Palate—soft, hard, alveolus, lip-unilateral
Group 4	Palate—hard, soft, alveolus, lip-bilateral



Classification of lip

Code	Location and type of defect
Group 1	Lip—notching
Group 2	Lip—upto nasal septum
Group 3	Lip—involving nasal septum bilaterally

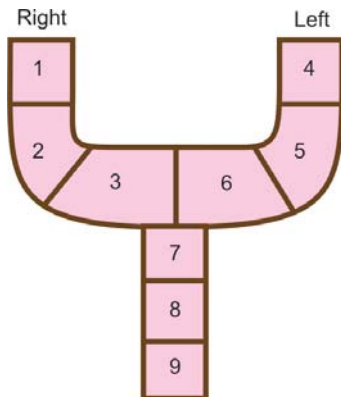
Embryologic classification—Fogh and Andersons

Code	Location and type of defect
Group 1	Hare lip – single, double
Group 2	Hare lip and cleft palate- single, double
Group 3	Cleft palate

Symbolic classification – Kernahans Striped Y

Upper arm – alveolus, hard palate upto incisive foramen

Lower arm – represents hard and soft palate
Area involved is shaded



Clinical Features (Figs 19.2 to 19.4)

- The least unaesthetic form of cleft is the mild cleft of the lip and most unaesthetic form is the bilateral cleft lip and palate.
- Unilateral cleft lip and palate – major segment of alveolus is on non-cleft side, lip is distorted and nose is flattened on cleft side.
- Bilateral cleft lip and palate – premaxilla is rotated and everted out of the oral cavity.
- In case of palatal cleft there is communication between oral and nasal cavities. So there is difficulty while feeding as the fluid tends to flow out of the nose.
- There may be abnormal frenal attachment in the form of multiple webbing seen adjacent to the cleft.
- There are chances of increased incidence of congenitally missing teeth usually the lateral incisor or increased frequency of supernumerary teeth. Natal or neonatal teeth are also found.
- If the lateral incisor is present they may erupt ectopically either palatally or within the cleft. If they erupt adjacent to the cleft, there may be deficiency of the supporting alveolar bone leading to premature loss.
- Other changes that may be seen are hypoplastic teeth, microdontia, macrodontia, fused teeth, etc.
- The central incisor may be rotated or linguoverged.
- Maxillary canine usually erupts late with a difference of 1-2 years, due to its ectopic position adjacent to the distal margin of the cleft.
- There may be blockade of the eruption of second premolar indicating arch length problems.
- Anterior end to end or cross bite may also be observed.
- Other associated problems may be – velopharyngeal incompetence, vestibular deficiency and mid face retrusion.



Fig. 19.2: Unilateral cleft of the lip

Kernahan and Starte's classification

	Unilateral	Median	Bilateral
Cleft palate only	Complete	Complete–Premaxilla is absent	Complete
	Incomplete	Incomplete – Rudimentary premaxilla	Incomplete
Cleft of secondary palate only	Complete	Incomplete	Submucous
Cleft of primary and secondary palate	Complete	Complete	Complete
	Incomplete	Incomplete	Incomplete



Fig. 19.3: Bilateral cleft of the lip



Fig. 19.4: Cleft involving only the palate

Management of Cleft Lip and Palate

The treatment of cleft lip and/or palate is divided into different stages:

- a. Presurgical management
- b. Stage I
- c. Stage II
- d. Stage III
- e. Stage IV.

Team members for the management of cleft lip and cleft palate includes:

1. *The pedodontist* is involved in the fabrication of a feeding plate and obturator. He or she can assist in planning different feeding techniques that is best suited for the child.
2. *The pediatrician* responsible for patients overall maintenance of health.
3. *The orthodontist* identifies problems, predicts growth and provides comprehensive orthodontic care.
4. *Plastic or oral surgeon* responsible for surgery when needed.

5. *Speech pathologist* monitors speech and offers therapy
6. *ENT surgeon* performs test to identify any hearing difficulties, as parent will not be able to recognize hearing problems
7. *Psychiatrist* evaluates emotional, behavioral and social development. Emphasis is placed on the patients ability to cope with emotional and physical stress created by the cleft defect.
8. *Social worker* acts as the patients advocate and aids in psychological assessment. Helps the parents in guiding to the doctor and provide medical care.

Presurgical Management

It includes counseling the parent and feeding the child

Counseling: The parents usually are not prepared and the birth of a child with cleft comes as a shock especially to the mother. It is difficult for the mother to accept such a child with the deformed little face and it is at this time, she is in need of psychological support from her obstetrician and pediatrician initially and later from others. As Cooper has stated, the initial management is “Feed the child and treat the mother.”

Feeding for infants with cleft palate: Feeding is a major problem in children with cleft palate. The mother should be encouraged to breastfeed. This is desirable from a nutritional point of view and also strengthens the bond between the mother and the child. If for some reason breastfeeding is not possible, bottle is used. Normally the infant creates a negative oral pressure while sucking the milk. But the cleft palate children cannot form a negative pressure. Mechanical feeding is thus suitable if breastfeeding is difficult.

Two main methods are employed: (a) Spoon and (b) Bottle. Both are used along with feeding plate.

Spoons can be used that are either conventional or attached to a special type of feeding bottle which acts as a reservoir. A spoon with a deep trough is recommended. It is especially useful immediately following repair of the lip because it eliminates the chances of damaging the lip. A spoon can also be fixed to a palatal attachment, such that the spoon position



can be adjusted and locked in the position found to be satisfactory.

Cleft palate babies who are bottle fed, should have a teat which is soft in texture and has a large hole, to compensate for the slow draw of milk or fluid. Bottles with long nipples having opening (oblique opening) just enough to permit the milk to flow freely but not to permit milk to flow freely when inverted. Proper positioning of the child is also important. The mother should cradle the baby in her arm in a semisitting posture with the infant's body upright and tilted slightly backward. Feeding is slow and the child tends to lose major part of the feed, due to its disability. Feeding bottle to which an acrylic plate is attached can be used which closes the defect and prevents fluid from entering the nasal cavity.

Feeding Plate (Fig. 19.5)

Design: The feeding plate is made of acrylic extending over the palate covering the cleft. The plate is held in place by a 0.9 mm stainless steel wire extending from the plate out of the oral cavity on either side. The wire is then bent over the cheek without touching it. This extended wire portion prevents the accidental slippage of the feeding plate and also provides some retention.



Fig. 19.5: Feeding plate in position

Fabrication: The lollipop impression technique is most simple for obtaining the primary impression. As the name suggests, the tray is like a lollipop in shape. A wooden flat tongue spatula or a flattened old teaspoon also serves the purpose. Impression compound can be used to function as a tray as well as impression material. The cast is prepared and feeding plate is fabricated with self cure or heat cure acrylic.

The feeding plate is placed in the oral cavity only during feeding.

Stage I: Management from Birth to 18 Months

Birth to three months: Includes presurgical arch alignment, use of stimulation appliances, and cheiloplasty

A. Pre-surgical arch alignment: In bilateral clefts the early treatment combines the expansion of the two maxillary segments and repositioning of the premaxillary segment into a position of stability between the lateral segments.

When there is a unilateral cleft, due to muscle pull, the major segment is pulled towards the non-cleft side and in the bilateral clefts the premaxillary portion moves labially and becomes everted. So if an opposing and a shearing force are applied the distortion can be minimized and the major and minor segments can be pulled together. This makes the task of the plastic surgeon easier.

This can be accomplished by the construction of a simple intraoral appliance on a series of corrected models modified progressively towards normality. Their function is to mould the deformed arch into correct anatomical alignment. This treatment begins after birth as soon as possible.

Advantage of pre-surgical arch alignment

- Provides a sound basis for lip repair and affords support to the nostrils
- Restores the continuity of the lip
- Permits function of the circumoral musculature.

This appliance is fitted over the protruding and laterally displaced premaxilla and anchored to the infants head with a Bonnet appliance. By the application of the sequentially increasing forces to the premaxilla with elastic straps attached to the



prosthesis, the premaxilla can be aligned in midline. The time required is about 3-4 weeks. Equal pressure is maintained for 1-2 months to retract the premaxilla in between the lateral segments.

Design and construction: Impression is made and the cast prepared. The model is examined and planned for sectioning. The model is divided with a fine saw through the cleft from the posterior border to the premaxillary region. Template can be used as an aid to the degree of correction and repositioning that is required. After sectioning, they are repositioned with wax and this model is duplicated. Baseplate is adapted over it. Blocks are made on the ridges with wax. Wings are fabricated which extend round the corners of the child's mouth and prevents the child from swallowing the appliance. The wax up appliance is tried in the child's mouth. Then final wax of the appliance is made, it is flaked, packed and acrylized. Holes are made in the ends of the wings for tapes. The appliance may be reinforced by applying extra oral strapping in the form of a bow to the premaxilla. Care is taken not to over correct by the pressure of the strapping, which will bring maxillary arch within the mandibular arch, causing malocclusion in later life.

- B. *Stimulation appliances:* This technique was described by McNeil in 1955 by taking advantage of normal growth factors. Forces which are within the limit of tolerance will act to stimulate bone apposition if they are applied to a particular region and in such directions that they can be regarded as intensified normal forces.

The appliance is shaped as a spring activator which lies in contact with the palatal processes and are designed to exert a gentle pressure, which produces hyperemia of the tissues. An increase of blood supply is likely to cause proliferation of the edges of the palatal defect. The appliance is used prior to surgery of the palate. No pressure is applied to the edges of the cleft.

Construction: Impression is made and casts prepared. Teeth are selected for cribs to provide retention. The areas of pressure are marked out on the palate and

covered by wax. A horse-shoe shaped wax is adapted to fit round the collar of the teeth, leaving the palate clear. 0.6 mm wire is bent and extended from horse-shoe shaped wax down into the wax pads. The waxed up pattern is sealed to the duplicated model, flaked and acrylised. After trimming and polishing the appliance is fitted.

- C. *Cheiloplasty:* 3 Ten's law is a simple guide to determine if a child is ready for surgery – child should be 10 weeks old, weigh 10 lbs and should have 10 gm. Hb/100 ml. Logan's bow is given to reduce the tension in the wound following surgery. It remains in place for 5 days till sutures are removed.

Three to nine months: Management includes placement of an obturator and bone grafting procedures:

- i. Following lip closure, there is collapse of the maxillary arch, due to increased tension placed on the segments by the repaired lip. A prosthetic device termed as intra oral maxillary obturator when placed in the mouth, prevents this collapse.
- ii. When the maxillary segments are in good alignment and abutted across the cleft sides, the patient is ready for cleft bone graft, i.e. at about 6-9 months. The primary grafting is done at 6-9 months, early secondary at 2-4 years, secondary grafting at 6-15 years, late secondary grafting during adulthood.

There may be some problems associated with early bone grafting such as:

Limitation of midfacial growth, manifested as reduced anteroposterior development, increased incidence of crossbite, reduced area of upper jaw.

Obtulators: They provide a false palate against which the infant can suck, reducing the incidence of feeding difficulties. It also provides maxillary cross arch stability, preventing arch collapse after lip closure. It aids in orthopedic molding of the cleft segments into approximation before primary alveolar cleft bone grafting.

- Indications for the use of obturators:
 1. To facilitate feeding prior to surgical intervention.
 2. As an interim means of treatment.



3. Where surgery is contraindicated, because of existing disease.
 4. Where surgical procedure would result in an inferior functional result.
 5. Unwillingness of the patient to undergo surgical treatment.
 6. Where surgical correction has failed to produce a satisfactory result.
 7. Where long hospitalization is precluded by financial considerations.
- Requirements of the material used for obturators
The material should be:
 - Non-irritating to the tissues
 - Light in weight
 - Hygienic and easily cleansable
 - Durable
 - Pliable
 - Poor conductor of heat
 - Easy to manipulate.
 - *Materials used:*

<i>For palate</i>	<i>For velum</i>
Acrylic	Acrylic, Latex
	Chrome cobalt
	Chrome cobalt, Polyvinyl chloride
Cast gold	Cast gold, rubber based material
Stainless steel	Sheet rubber

Hinges play a very important role while fabricating the velum obturators, which enable the artificial velum to make delicate movements.

Different Types of Hinges Available are:

1. McNeil Hinge
2. Ball and socket hinge
3. Rod and tube hinge
4. Cast hinge

Twelve months to two years: Management in this period includes palatoplasty. Closure of the palate is accomplished during this period. The main purpose being to facilitate the acquisition of normal speech.

Different surgical technique for palatoplasty include,

- For soft palate
- Three layer closure
 - Veau-Wardill-Kilner two flap push back procedure
 - Primary pharyngeal flap
- For complete cleft palate
- von Langenbeck's repair
 - Sliding mucoperioosteal flap
 - Bilateral Vomer flap
 - Primary veloplasty

Stage II: Management from 18 Months to 5 Years (Primary Dentition)

Treatment during this phase is initially focused on establishing and maintaining optimal oral health. Meticulous daily oral hygiene for the child is established to reduce the possibility of developing dental caries. An increase in periodic recalled examination at 3-4 months interval enables the dentist to intercept areas of decay. Extent of malocclusion is less apparent. Treatment is difficult in the primary dentition because of the lack of good teeth for anchorage. Level of cooperation obtained by the patient is also limited and there may be relapse due to growth.

Stage III: Management from 6 Years to 11 Years (Mixed Dentition)

Treatment is concentrated at correction of traumatic occlusion and posterior segmental alignment. Maxillary expansion, to correct posterior segmental collapse is accomplished by routine palatal expansion. Secondary alveolar cleft bone grafts offer maxillary arch continuity and aids in closure of the oronasal fistula. It also supports the alar base of the nose. After 2 months healing period, tooth can be moved into the newly grafted bone and the bone will respond to the tooth movement as any normal bone would. It is observed that canines can and do erupt through the graft. If eruption is delayed surgical or orthodontic intervention is appropriate. Success rate is usually 90%.

Stage IV: Management from 12 to 18 Years (Permanent Dentition)

Treatment during this stage comprises of comprehensive orthodontic and surgical management of permanent



dentition. Growth is nearing completion during this stage and magnitude of any deformity can be readily assessed. Hence it forms the appropriate time to start orthodontic or surgical procedure. Cross bite can be corrected by rapid maxillary expansion, class III malocclusion by elastic traction with fixed appliance.

Retention period required may be longer or sometimes permanent.

Speech and hearing problems associated with cleft and its management: It has been estimated that 50% of the patients suffer from some type of speech problems.

In cleft palate cases, there is defect in articulation, resonance and hearing problem. Rhythm may also be disrupted because of the nasal leakage of air that makes speaking in phrases or sentences in a single breath of air very difficult.

When there is velar insufficiency there is no distortion of the nasal sounds like—m, n, ng.

In case of severe nasal obstruction,

- Bilabial plosives [b] will be replaced by [m], e.g. Me for be.
- Linguoalveolar [d] will be substituted for n., e.g. Doe for no.
- Voiced velar g' will be substituted for linguoalveolar ng., e.g. rig for ring.

Hearing problems are often associated with clefts of the palate. These problems are usually caused by middle ear infection, which are in turn due to the exposure of the eustachian tube to bacteria and food in the patient with cleft palate.

Management: Speech therapist should be consulted for speech related problems. Speech therapy includes:

1. Mother is encouraged to talk to the child. This is called indirect speech therapy.
2. Direct speech therapy—patients are encouraged to produce words which stimulates tongue and lip movement.
3. Articulation therapy—proper tongue positioning and movement is shown to the child and asked to repeat

Despite all these measures, a certain proportion of patients are left with inadequate speech. This can be related to many variables like low intelligent quotient,

hearing loss, poor psychosocial family environment, presence of residual defects in the soft and hard palate and severe dento alveolar deformities.

Down's Syndrome

It is the most common chromosomal aberration seen with incidence rate of 1.5 per 1000 live births. Survival rate is very high in patients with this syndrome. The most common chromosomal abnormality seen is trisomy 21 (presence of an extra autosome 47XX in females and 47XY in males). About 4% have translocation of chromosome 21 and 1% are mosaics, i.e. there is a population of cells with both normal and trisomic chromosome numbers (a mixture of 46 and 47 chromosomes). Increased maternal age seems to be the prime cause.

Dental Management of Patient with Down's Syndrome

- Abnormalities related to Down's syndrome that can affect dental treatment are congenital heart disease and behavioral problems due to retardation.
- Patient with Down's syndrome can be treated in dental office with a tolerant and empathetic approach. The dentist should attempt to introduce dental treatment in a non threatening and friendly manner.
- They are very friendly and mildly affected patient are often very co-operative.
- Premedication, however, may be necessary to allay apprehension in some severely affected patients.
- Since these children have associated cardiac abnormalities, antibiotic prophylaxis is required before any invasive dental procedure.
- Detailed description is also given in chapter 26.

Renal Diseases

Renal failure leads to a drop in glomerular filtration rate, which results in progressive hypertension, fluid retention and build-up of metabolites that are not excreted normally.

Features and Dental Importance

- Children usually exhibit growth retardation.



- They are pale and anemic.
- Bleeding tendency due to capillary fragility and thrombocytopenia is positive.
- Children on dialysis are most of the time on anticoagulant therapy.
- Caries rate is lower in children with end stage renal disease, possibly caused by ammonia being released in saliva.
- Uremic stomatitis develop when serum urea is over 300 mg/ml.
- Teeth calcifying during renal failure will exhibit chronological hypoplasia or hypomineralization. They may be brown or green due to incorporation of blood products such as biliverdin.
- Additional dose of drugs should be given after hemodialysis.

Drugs to be Avoided

- Paracetamol
- Penicillin
- Tetracycline
- Chloramphenicol.

Prognosis of Down's syndrome

- about 25-30% die during the first year of life
- 50% die during the first 5 years
- the most frequent causes of death are congenital heart disease and respiratory tract infections

Liver Disease**Features and Dental Importance**

- There is reduction of production of vitamin K dependent clotting factors, which may result in increased bleeding tendency.
- Patients are usually managed with high dose steroids and are immunocompromised.
- Increased destruction of red blood cells are seen leading to anemia.
- Consultation with the pediatrician is necessary.
- Aggressive management of caries with extraction of suspected teeth should be done after replacement of clotting factors.

- Coagulopathies are usually managed with fresh frozen plasma to replace deficient clotting factors.
- Antibiotic prophylaxis required.

Drugs to be Avoided

- Acetaminophen
- Aspirin
- Lignocaine
- Mepivocaine
- Procaine
- Ampicillin
- Tetracycline
- Barbiturates
- Chloral hydrate
- Promethazine.

Diabetes Mellitus

Type I or insulin dependent diabetes mellitus is the most common form in children. This is due to damage of the pancreatic islets. The damage may be due to bacterial or viral insult. Auto immune mechanism has also been suggested in the destruction of the insulin producing β cells. The goal of treatment is to maintain blood glucose at a normal level and thereby reduce the potential complication of hyperglycemia and ketoacidosis.

Diagnosis of diabetes mellitus

- Fasting blood glucose level—120 mg/dL
- Abnormal oral glucose tolerance test
- Elevated glycosylated hemoglobin test value

Features and Dental Importance

- Periodontal disease is the most consistent oral finding in patients with poorly controlled diabetes. These patients exhibit increased alveolar bone resorption and inflammatory gingival changes. This may mimic the clinical manifestation of aggressive periodontitis.
- Xerostomia and recurrent intraoral abscesses may be present.
- Enamel hypocalcification and hypoplasia along with reduced salivary flow can predispose these patients to an increased frequency of caries.



- Altered flora with an increase in *Candida albicans*, *Haemolytic Streptococci* and *Staphylococci*.
- For routine dental appointments, the patient should eat a normal meal before the dental procedure and a glucose source should always be available to treat the onset of hypoglycemia.
- Fasting before a general anesthesia requires careful adjustment of hypoglycemia therapy because hypoglycemia related to anesthesia can be fatal.
- Healing can be delayed.
- All children treated under general anesthesia should be admitted to hospital and their case supervised by the pediatric endocrine team. Dextrose and insulin infusion is administered to avoid complications with fasting.
- Procedures should be done under prophylactic antibiotics.

Hypopituitarism

Features and Dental Importance

- Facial and skull measurements are smaller.
- Face appears immature with open bite.
- Skeletal development is consistently more retarded than craniofacial development, but tooth eruption and root formation can be delayed or incomplete.

Hyperpituitarism

Features and Dental Importance

- Precocious and accelerated development of the craniofacial skeleton.
- Prognathism is common.
- Accelerated dental development and eruption, enlarged tongue and facial features.
- Marked thickening of the cranium and cortical bone of the mandible.
- Overdevelopment of osseous structures with poor maturation and quality with hypercementosis.
- Management focuses on the craniofacial malformations and no contraindications exist for comprehensive dental health care.

Hypothyroidism

Features and Dental Importance

- Decreased vertical facial growth, decreased cranial base length and flexure, maxillary protrusion and open bite with immature facial patterns.

- Delayed eruption and increased spacing of teeth.
- Developmental retardation and hypoplasia.

Hyperthyroidism

Features and Dental Importance

- Accelerated growth and development of the craniofacial complex and skeleton.
- Precocious eruption of teeth.
- Periodontal / periapical destruction and osteoporosis
- Increased vertical facial height with open bite and mild prognathism.
- Principle risk is associated with general anesthesia as they are at risk of developing congestive cardiac failure which may be precipitated by general anesthesia.
- Untreated patient is also at risk from infection or surgical procedures since a thyroid crisis may be precipitated.
- Oral infections, directly or through toxic substances may aggravate hyperthyroidism. Oral infections should be treated aggressively.
- Antithyroid drugs may produce parotitis and agranulocytosis, which predisposes the patient to bleeding episodes, ulceronecrotic lesions and oral infection.

Hypoparathyroidism

Features and Dental Importance

- Circumoral paresthesia and spasm of the facial muscles.
- Hypoplasia of enamel, hypodontia and root anomalies.
- Delayed or arrested tooth eruption.
- Acute and chronic oral candidiasis.

Hyperparathyroidism

Features and Dental Importance

- Associated with mobility and drifting of teeth with no apparent pathologic periodontal pocketing leading to malocclusion.
- Metastatic soft tissue calcification is common.
- Radiographic features includes periapical radiolucencies and root resorption with loss of lamina dura and generalized loss of radiodensity.



- Routine treatment involves no modification unless associated with medical complication.
- May be associated with cardiac arrhythmias which increase the risk of serious problems during general anesthesia.
- Risk of pathological fractures may be a complication of oral surgical procedures and splinting of teeth may be required.

Respiratory Disease (Asthma)

Features and Dental Importance

- An acute attack during the procedure is a possibility
- If the patient is on steroid medication it may cause extrinsic staining of the teeth due to changes in oral flora and may also predispose to candidiasis and the child may also be immunocompromised.
- Regular prophylaxis is required if extrinsic stains are present.
- Dental procedure in children who have been hospitalized for their asthma in the last 12 months and / or those managed with steroids should be done in hospital environment under pediatric care.
- There is no contraindication to the use of nitrous oxide, but should be avoided during acute illness.

Immunodeficiency

Features and Dental Importance

- Associated with candidiasis, severe gingivitis, gingivostomatitis.
- Conditions such as recurrent aphthous ulceration, recurrent herpes simplex virus infection are common.
- Premature exfoliation of primary teeth.
- Recurrent bacterial infections, especially pneumonia and skin lesions.
- Prevention and regular review of oral health is important.
- Prophylactic antibiotics is required.
- Chlorhexidine 0.2% pretreatment mouth wash is recommended.

Classification of immunodeficiency conditions:

1. Neutrophil disorders
2. Immunodeficiencies
 - Primary – B cell defects, T cell defects
 - Acquired–HIV infection, drug or chemotherapy or radiotherapy induced
 - Combined

Epilepsy

Epilepsy also referred to as a seizure disorder is a common neurological condition that is characterized by seizures occurring due to abnormal or excessive neuronal activity in the brain.

Classification

There are five types of epilepsy, they are:

1. Grand mal seizures
2. Petit mal seizures
3. Psychomotor seizures
4. Focal seizure (Jacksonian seizures)
5. Self induced seizures.

Grand mal seizures:

- Onset is rapid and preceded by momentary aura.
- Associated with tonic and clonic phases of muscular spasm.
- Patient loses consciousness and becomes pale. Pupils dilate, eyeballs roll upwards or to one side, the face becomes distorted and there is often rapid contraction of the jaw muscles. Micturition and defecation may occur.
- Patient may experience cyanosis during the tonic phase (continuous tension or contraction) lasting for 20-40 seconds.
- Clonic phase (alternating series of contractions and partial relaxation) may last for several minutes.
- Patient wakes up from seizure with severe headache and in a general state of confusion.
- A patient who experiences a grand mal seizure in the dental office should be handled conservatively and be put in a position in which he cannot harm himself possibly on the floor away from the dental equipment.



- If the seizure is prolonged, administration of oxygen may be necessary.
- A rubber or plastic mouth prop has to be inserted to prevent the patient from biting his tongue. A tongue blade wrapped with gauze and adhesive may be utilized.
- It is usually sufficient that the dentist wait until the seizure stops and then evaluate him.
- Recovery may be quick or patient may be irritable.

Petit mal seizures:

- Appears between 3 years of age and puberty.
- More common in girls.
- Consists of transient loss of consciousness.
- May occur once or twice a month or very frequently at less intervals and lasting for less than 30 seconds.
- Other features are upward rolling of eyes, moving of the lids, drooling or rhythmic nodding of the head or slight quivering of the trunk and limb muscles.
- They may also go unnoticed.

Psychomotor seizures:

- Difficult to recognize and control.
- Slight aura is manifested as a shrill of cry or an attempt to run for help.
- Child is often drowsy or sleeps for a short time after the spell.
- Seizure consists of loss of postural tone.
- 1-5 minutes of unconsciousness is followed by normal sleep or activity.
- No tonic or clonic movements present.

Focal seizure (Jacksonian seizures):

- Produced by injury to the brain.
- Seizures are clonic in nature.
- Muscles involved are the ones most specialized for voluntary movements in the hand, face and tongue.

Self induced seizures:

- It is possible for some children to induce petit mal or grand mal seizures by over breathing, watching a blinking light or by performing some other form of learned behavior.
- In such cases drug therapy alone is usually unsatisfactory

- Patient by doing so tries to draw attention to himself and is usually associated with complex family problems and psychiatric consultation is indicated.

Anticonvulsant drugs commonly used in children and their toxic reactions

Drug	Indications	Toxic reactions
Phenobarbital	Safest Used as adjunct and drug of choice for initial trial	Rare Drowsiness, increased excitability, dermatitis
Mephobarbital	Phenobarbital derivative-No advantage over phenobarbital	Same as for phenobarbital
Phenytoin (dilantin)	Good for management of grand mal and psychomotor epilepsy, may accentuate petit mal, often used with phenobarbital	Few—gingival hyperplasia, nervousness, ataxia, rash, nystagmus, nausea, vomiting
Primidone	Second choice for grand mal and complicated major seizures and psychomotor seizures	Urticaria, diarrhea, nausea, vomiting
Ethosuximide	First choice for true petit mal	Leukopenia, nausea, vomiting, headache, drowsiness, liver dysfunction

Features and Dental Importance

- Gingival enlargement.
- Precipitation of seizure during the surgery.
- Most convulsive disorders are controlled through medication and pose few problems in dental treatment. It should be made sure that the child has taken the daily dose of medicines.
- Since anxiety is a frequent precipitation factor, premedication with minor tranquilizers will be effective.
- These children often arrive at the dental office in a slightly sedated state due to the CNS depressed activity of anticonvulsant medications.
- Use of mouth props is mandatory during treatment because once the seizure begins, it is difficult to insert any device to prevent intraoral injury due to clenching of the jaws.
- If appliances are indicated for tooth movement or tooth replacement purposes, fixed appliance is



preferred because there is less chance of dislodgement.

- Gingivectomy is the treatment of choice in case of gingival hyperplasia that usually occurs with phenytoin therapy. They usually tend to recur. Hence the drug or the dose can be modified upon consultation with the pediatrician.
- In case an episode occurs:
 - Stop all dental procedure
 - Maintain the mouth prop in place
 - Loosen the patient's clothing
 - Turn the patient's head to the side, to prevent aspiration of oral fluids
 - After the seizure, it is better to discontinue the therapy. If a cavity is already prepared, either temporize or complete the final restoration.

Childhood Autism

Kanner in 1944—first described it as 'early infantile autism'

It was considered as a syndrome and great variations in severity and manifestations of the disturbances were observed. One symptom common to all children with the disease was an inability to relate appropriately to people and situations.

Features and Dental Importance

- Self sufficient and introvert.
- Wants to be left alone, exhibits extreme resistance to being held. Eye contact is difficult to achieve.
- Have little or no attachment to their parents and remain detached.
- Relate poorly to persons, they frequently relate well to objects.
- They will remain occupied with moving or shiny inanimate objects for hours, e.g. rotating fan, etc.
- They may typically display affection or anger with a toy.
- Language is impaired.

There are different opinions regarding the etiology of autism, such as:

- Personalities, attitudes and behavior of the child's parents, play a major role
 - Autism is an early manifestation of childhood schizophrenia. But schizophrenia is a familial disease whereas infantile autism does not have familial tendency. Since most parents of autistic children are found to be highly intelligent, well educated and serious minded persons, the concept of parental causation is difficult to accept.
- Bizarre behavior makes dental management a challenge.
 - Oral hygiene is often very poor because of finicky dietary habits.
 - The problem with behavior modification is the time, energy and patience that are required.
 - Ketamine can be used successfully as a sedative on an outpatient basis. But when there is extensive treatment required, general anesthesia is the method of choice.

Blindness

About 10% of the children below 20 years of age have visual defects.

Anyone providing treatment for these patients must first determine the degree of sight present. Overall personality defects and speech disorders are most frequently observed along with blindness.

Features and Dental Importance

- Allow the child to make full use of their tactile sense and their sense of smell when familiarizing them to the dental environment and dental procedures.
- Offer verbal and physical reassurance to the child, and remember they cannot see your smile.
- Paint a picture in the mind of your patients by describing the environment, the dental chair, equipments and the treatment and the environment throughout the procedure. A startle reflex may occur if instruments are introduced into the mouth without warning.



- Many visually impaired people are photophobic. It is important to ask parents and children about light sensitivity. Safety glasses should preferably be tinted.
- Oral hygiene education is given to the patient by introducing the surfaces of the teeth to be cleaned by having the patient first feel the teeth of a teaching model and then using his fingers in his own mouth.

Bleeding disorder can be due to many reasons, they are

1. Platelet disorders
 - Thrombocytopenia
 - Thrombocytosis
 - Platelet function disorder
2. Vitamin C deficiency.
3. Connective tissue diseases

Deafness

Features and Dental Importance

- Investigate how the child communicates
- A common fault is to talk loudly rather than slowly. If the patient can read the lip, face the child and speak clearly and slowly.
- It is useful to learn basic sign language.
- Deaf children may be very sensitive to vibration and so introduce high speed and low speed drills carefully.
- If a hearing aid is worn the volume may need adjustment.

Bleeding Disorder

Features and Dental Importance

- Bleeding disorders are due to failure in the initial clot formation.
- Children with thrombocytopenia will bleed immediately after trauma or surgery, unlike hemophiliacs who usually start to bleed 4 hours after the incident.
- Oral manifestations are petechiae and purpura, spontaneous bleeding and prolonged episodes of bleeding after minor trauma or tooth brushing are seen
- Platelet level preferably should be $> 50 \times 10^9$ per liter before extraction.
- Endodontic procedures may be preferable to extractions in order to avoid the need for platelet transfusion
- Good surgical technique and readily available local measures to control bleeding is important.
- Block injections should be avoided.
- Epsilon-amino-caproic acid 100 mg/kg loading dose and then 30 mg/kg four times a day for 7 days.

Coagulation Disorders

Coagulation disorders can be of three types, they are:

1. Hemophilia A- factor VIII deficiency.
(Normal level is 50-200%, Mild deficiency occurs when the level fall to 5-25%, moderate when it is 2-5% and severe when it is less than $<1\%$).
2. von Willebrand's disease
3. Christmas disease.

Features and Dental Importance

- Consultation with physician.
- Local measures to control hemorrhage should be initiated.
- There should be minimal trauma during procedures.
- No block anesthesia without factor cover should be given, due to risk of hematoma.
- Intraparodontal injections may be used but with great caution.
- Nitrous oxide sedation can be effective during restorative procedures.
- Extractions must never be performed without consultation.
- Endodontic procedures can be safely carried out without factor cover.
- Periodontal therapy with scaling and subgingival curettage requires factor replacement.
- Rubber dam should be used to protect soft tissues.

Hemophilia A

Hemophilia A is caused due to deficiency of factor VIII, also called as antihemophilic factor. Hemophilia A is transmitted as an X-linked recessive trait. Based on the level of factor present it can be classified into severe ($<1\%$), moderate (1-5%) or mild ($>5\%$) deficiency.



Spontaneous bleeding in the joints, skin, muscles, etc is common in case of severe and moderate deficiency. Patients with mild deficiency bleed less commonly and are identified most of the time during routine blood investigation or following a trauma.

Features and Dental Importance

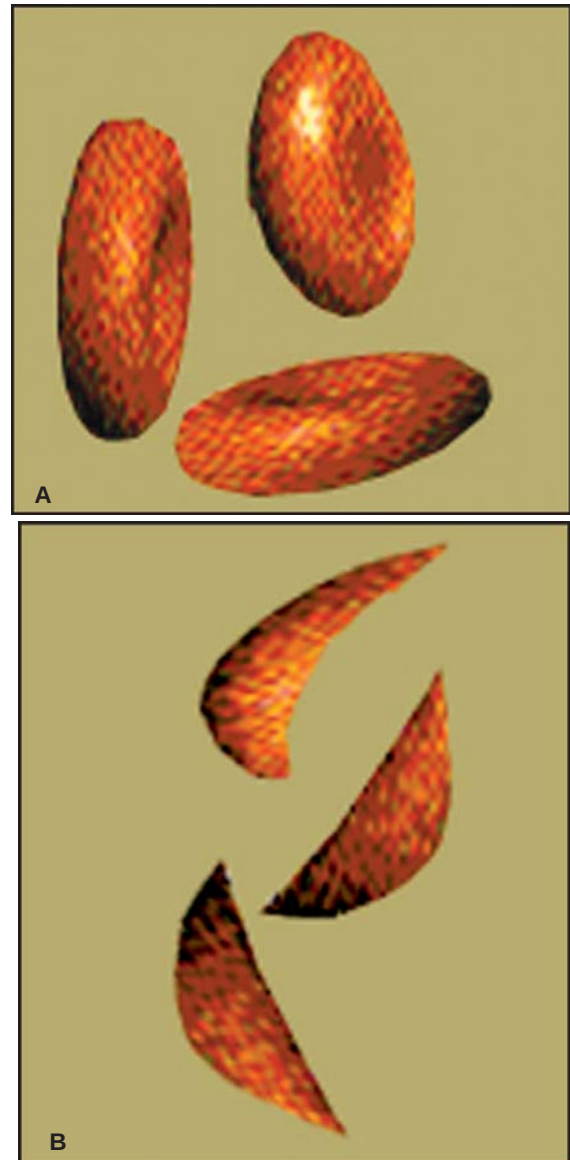
- Dental treatment should be done following replacement therapy.
- Minor bleeding can be controlled with 30 to 50% of replacement but severe hemorrhage requires 100% replacement.
- Half life of factor VIII is 10-12 hours.
- Emphasis should be given for prevention of oral disease.
- Increased risk of hematoma formation, hence nerve blocks are avoided.
- General anesthesia also carries the risk of bleeding similar to surgery, during endotracheal intubation
- Epsilon-amino-caproic acid should be administered prior to any procedure.
- Microfibrillar collagen hemostat (MCH) is advocated as local hemostatic agent.

Sickle Cell Anemia

It is a hereditary type of chronic hemolytic anemia, characterized by peculiar microscopic appearance of sickle or crescent shaped erythrocytes in the blood (Fig. 19.6). There is substitution of valine for glutamine in the β globin chain of the hemoglobin. It is common in females and manifests before the age of 30 years. The patient is weak, short of breath, and easily fatigued. Pain in the joints, limbs, and abdomen, nausea and vomiting is common. Other features are systolic murmur and cardiomegaly.

Features and Dental Importance

- Mild to severe generalized osteoporosis and a loss of trabeculation of the jaw bones with the appearance of large, irregular marrow spaces.
- Lateral skull radiograph demonstrates 'hair on end' appearance.
- Dental treatment should be scheduled shortly after blood transfusion.
- Stress should be minimum, as significant stress might decrease the child's ability to oxygenate tissues adequately.
- Control of infection is important as most of the patients with sickle cell disease have generalized osteoporosis of the mandible and greater tendency to develop infection, which could in turn precipitate a sickle cell crisis.



Figs 19.6A and B: Changes seen in red blood cells; (A) Normal Red blood cells; (B) Sickle shaped cells



- Functional asplenia may result due to chronic fibrosis of the spleen.
- For sedation, only drugs that do not depress respiration should be used.
- Local anesthesia is not contraindicated, but drugs that tend to cause methemaglobin should be avoided.

Thalassemia

- Two types of thalassemia exists— α thalassemia (minor) and β thalassemia (major).
- There is production of unstable hemoglobins that damage the erythrocytes and increase their vulnerability to destruction. It is observed within the first two years of life. The child has a yellowish pallor of the skin with fever, chills, malaise and generalized weakness. Splenomegaly and hepatomegaly may cause protrusion of the abdomen. Intercurrent infection are seen and the child may die within a few months.

Dental Implications and Management

- Mongoloid face with prominent cheek bones and protrusion of maxillary anterior teeth and depression of the nasal bridge.
- Hair on end appearance in the lateral skull radiograph.
- Osteoporotic changes are seen.
- Consultation with the hematologist. Treatment is avoided if hemoglobin is less than 100 g/L.
- Dental treatment should be scheduled shortly after blood transfusion.

Leukemia

Leukemia is the malignancy of the hematopoietic tissues which is characterized by disseminated proliferation of abnormal leukocytes in the bone marrow. These cells replace normal cells in bone marrow and also accumulate in other tissues and organs of the body. Acute leukemia accounts for about half of all childhood malignancies and acute lymphocytic leukemia (ALL) is the most common.

Clinical manifestations are very variable and includes anemia, thrombocytopenia, granulocytopenia which is seen due to the replacement of normal bone marrow

elements by undifferentiated blast cells or direct invasion of leukemic cells.

Onset is insidious with history of irritability, lethargy, persistent fever, vague bone pain, and easy bruising.

Clinical findings include pallor, fever, tachycardia, adenopathy, hepatosplenomegaly, petechiae, bruises, gingival bleeding and evidence of infection.

Oral Manifestations

Oral manifestations are less common in children (29%). It includes regional lymphadenopathy, mucous membrane petechiae and ecchymoses, gingival bleeding, gingival hypertrophy, pallor and non-specific ulcerations. Gingival bleeding can be exaggerated in children with poor oral hygiene.

Infiltration of leukemic cells along the vascular channels can result in strangulation of pulpal tissue and lead to abscess formation in a sound tooth. Similarly the teeth may loosen as a result of necrosis of the periodontal ligament.

Skeletal changes seen in ALL is generalized osteoporosis caused due to enlargement of Haversian canals and Volkmann's canals. Radiographically there is generalized loss of trabeculation, destruction of the crypts of developing teeth, loss of lamina dura, widening of the periodontal ligament space and displacement of teeth and tooth buds.

Dental Management

- All elective procedure should be deferred for a child who has yet not attained first remission or is in a relapse.
- Routine preventive, restorative and surgical procedures can be provided for a patient who is in complete remission yet undergoing chemotherapy.
- Before the treatment it is advised to have a blood profile and platelet count taken on the same day.
- Pulp therapy on primary teeth is contraindicated in any patient with history of leukemia.
- Platelet count of above 50,000/mm³ is a must before performing any routine preventive or restorative procedure. Severe bleeding from gingiva either spontaneous or during brushing is seen as the platelet



level falls to below 20,000/mm³. Use of moist gauze or plain rinse can be recommended for such children instead of tooth brush.

- Absolute granulocyte count (ACG) is an indicator for host ability to suppress infection. Normal level is > 1500 / mm³. Elective dental treatment is deferred if the level fall to below 1000/mm³.

$$\text{ACG} = \frac{(\% \text{ PMN} + \% \text{ Bands}) \times \text{Total WBC}}{100}$$

- Candidiasis is common in children with leukemia. 5 ml of Nystatin oral suspension, (100,000 units/ml) is recommended to be swished for 5 minutes and then swallowed.
- Drugs such as aspirin should be avoided that alter platelet function.

Clinical features of leukemia

- Fatigue and weight loss
- Anemia
- Purpura
- Infection and febrile episodes
- Hepatosplenomegaly and lymphadenopathy
- Bone pain

Dental Effects of Radiation Therapy

- Salivary gland damage and xerostomia is temporary in children, because of the lower dosage of radiation and greater regenerative capacity.
- Lower incidence of radiation caries.
- Enamel hypoplasia, altered crown morphology, shortness and tapering of roots, abnormal root curvature, rootless teeth and tooth agenesis are common side effects.
- Micrognathia and retrognathia.

Dental Effects of Chemotherapy

- The chemotherapeutic agents do not differentiate the normal from the abnormal cells. Their target are the rapidly differentiating cells. Unfortunately even other cell such as the ameloblasts and the odontoblasts are damaged resulting in abnormalities of dental development.
- Microdontia, enlarged pulp chambers, shortening, thinning and blunting of root and delayed eruption have been found.

- Enamel opacities, hypocalcification and a high caries rate have also been noted.

Organ Transplantation**Dental Implication and Management**

- Immunosuppressive agents such as corticosteroids and cyclosporine are given to prevent the organ rejection following transplant. Cyclosporin is nephrotoxic and hepatotoxic and also causes hypertension. Gingival overgrowth results from treatment with cyclosporin.
- Elimination of all possible sites of infection is very important through meticulous oral hygiene program
- Teeth with large carious lesions even if not pulpally involved should be extracted. Primary teeth soon to exfoliate should also be removed.
- Gingivectomy is done to manage gingival overgrowth
- Antibiotics for invasive treatment should be prescribed.

Bone Marrow Transplantation**Dental Management**

- Dental treatment should be performed at least 2 weeks prior to induction of chemotherapy or total body irradiation to allow adequate healing.
- Chlorhexidine 0.2% mouthwashes and gels applied to the mucosa with toothettes to reduce mucositis.
- Local haemorrhage can be controlled with topical thrombin, E-amino-cuproic acid.
- Antibiotic coverage for all procedures.

Children on Anticoagulants

They are used for children with valvular heart disease and prosthetic valves.

Commonly used anticoagulant drugs are:

Warfarin—vitamin K antagonist (factor II, VII, IX and X) 3-4 days are required for full onset, and assessed by prothrombin level.

Heparin—Shorter acting, immediate onset, given IV—inhibits factors IX, X, XII.

Dental Management

- Prevention of infection is very important.



- Local measures to prevent excessive bleeding includes application of topical thrombin, packing with microfibrillar collagen hemostat or oxidized cellulose.
- Admission to hospital.

MANAGEMENT OF A PHYSICALLY HANDICAPPED CHILD DURING DENTAL TREATMENT

Dental Office Access

- Wider width of the doorways to allow easy movement of the wheelchair, etc.
- Equipments can be arranged on a trolley so that it is convenient to bring them near the patient.
- Dental chair should be adjustable for height to match different wheel chair designs.
- Additional time with the parent and the child is needed to establish rapport and dispel the child's anxiety.
- If patient cooperation is difficult to obtain then physical restraints or sedatives should be considered. Sedatives and physical restraints are considered in chapter 8.

Physical restraints for handicapped child

Consent of the parents should be taken prior to the use of physical restraints. They are useful and effective in facilitating the delivery of dental care for patients who need help controlling their extremities and for managing extremely resistant patients who need dental care but who are not candidates for general anesthesia.

parents or the dental auxiliary. Floss may be attached to the film through a hole made in the bite tab.

- Adequate protection with lead apron and thyroid collar should be provided to the patient and the assistant.

Preventive Methodologies

Preventing oral disease is the most desirable way of ensuring good dental health for any dental patient.

Home Care

- Parents or the guardian have the initial responsibility.
- Reinforcement of good home dental care and constant evaluation is required.
- Home dental care should begin in infancy with a soft cloth or an infant toothbrush.
- Parents should be taught the correct brushing techniques by safely restraining the child when needed.
- Wrapped tongue blades may be used to keep the child's mouth open.
- A plaque program for the disabled should be simple and yet effective. One method recommended is the horizontal scrub as it is easy and can yield good results.
- Some modifications can be made to the brush to help persons with poor fine motor skills improve their brushing techniques (Fig. 19.7). Electric tooth brushes can also be used effectively.

Diet and Nutrition

- It should be kept in mind the eating pattern of a child and the extent of disability while prescribing diet. For example a child with cerebral palsy may require the intake of pureed diet.
- Particular emphasis should be made on the discontinuation of the bottle feed by 12 months of age to decrease the likelihood of nursing caries.

Fluoride

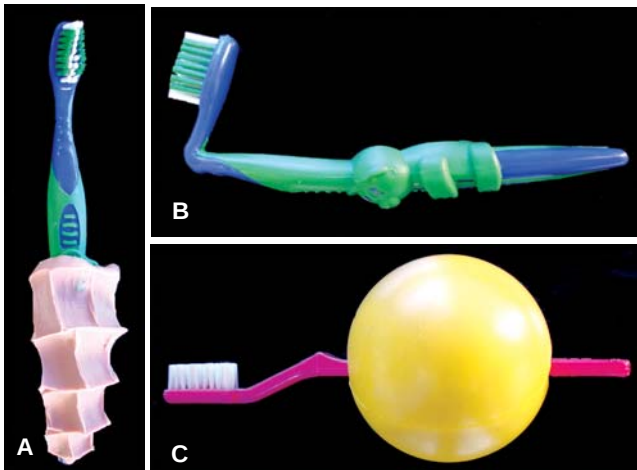
- The judicious use of systemic fluoride is very important in the comprehensive management of any dental patient.

First Dental Visit of a Handicapped Child

- Special attention should be given. Names and addresses of medical or dental personnel who have previously treated the patient are necessary for consultation purpose.
- Patients should be scheduled early in the day and sufficient time should be allowed to talk with the parents and the patient before initiating any dental care.

Radiographic Examination

- Modification needed to hold the child should be considered. Assistance may be required from the



Figs 19.7A to C: Modifications made to a normal tooth brush to be used by disabled child: (A) Impression of the hand grip in acrylic molded on to the handle, (B) Additional angulation provided to the brush as per necessary, (C) Rubber ball is perforated and the handle is passed through it

- Fluoride level of the patient's daily water supply should be estimated and the recommendation of the systemic fluoride depends upon this.
- Whether the patient lives in a fluoridated area or a nonfluoridated area, topical fluoride should be applied.
- Fluoride dentifrice and rinses should be prescribed to be used daily and depends on individual patient's ability to expectorate. Fluoride varnish are ideal for children who do not expectorate.

Pit and Fissure Sealant

It is shown to reduce occlusal caries effectively and should be used whenever indicated.

Disabled Children can be Divided into 3 Groups-for the Purpose of Teaching Oral Hygiene

- Self care group
- Partial care group
- Total care group.

Self Care Group

- Those able to brush their own teeth but needing some encouragement and minimal supervision.

- Easiest to work with.
- Modification of brushes may be necessary.
- Communication must be maintained with the parents and teachers, since the parents are usually the ones who supervise the individual in the daily care.

Partial Care Group

- Those able to carry out only part of their oral hygiene needs and requiring considerable training and direct supervision to complete the job properly.
- Individuals of this group will be moderately disabled and often retarded.
- They require close supervision and direct assistance to perform the routine tasks of everyday living.
- Patients of this group will not understand the long term benefits of brushing their teeth.
- In teaching this group, one must not expect rapid learning. Every step has to be repeated until it is mastered.

Total Care Group

- Those unable to assist in any way in their own care and must be assisted by a second party.
- Composed of mainly severely disabled who may never be able to be of much assistance in cleaning their own teeth.
- Electric tooth brush may be superior to conventional brushes and makes it easier for the parent or caretaker to master brushing the individual's teeth.

Position of the Child and the Caretaker

1. *Standing:* Caretaker stands behind the child and cradles the child's head in one arm, holding the lower jaw open in the same arm and brushing with the other. Usually used for the larger child or an adult.
 2. *Sofa:* Caretaker sits on the sofa and the child lies with his head on the caretaker's lap.
 3. *Lap:* Caretaker sits on the chair and the child, usually a toddler lies on the lap with head slightly hanging down to assist in opening the mouth.
- Extra assistance in each position may be advantageous.



Modification of Tooth Brushes

This may be required as the children may find it difficult to hold the normal brush:

- Banded to the hand by the velcro strap.
- Handle of the brush can be lengthened by attaching a stick.
- Rubber ball perforated to hold the brush.
- Foam rubber can be rolled around the handle.
- Self cure acrylic handle can be added and hand impression made.
- Angulation can be given to the head of the brush.
- Bicycle handle bar.

Different types of responses exhibited by handicapped child may be as follows:

- Overwhelming fear—fight strenuously
- Relaxed and happy—have no fear and enjoy the entire session
- Some may tolerate only superficial examination and will not voluntarily set foot outside the waiting room area
- They may come to the dental operatory quite happily, show curiosity about the equipment, enjoy a ride on the chair yet resist an examination. They may clamp their mouth shut, purse their lips, gag, grab the examiners hands and pull them away or even resist more actively by biting, kicking or scratching.

FURTHER READING

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Chapter 20



Radiology in Pedodontic Practice

1. Introduction
2. Points to be Considered Before Planning for Radiographs
3. Guidelines for Prescribing Radiographs
4. Child Preparation and Management
5. Methods of Reducing\ Radiation Exposure
6. Radiographic Techniques Commonly Used in Children
 - Intraoral periapical radiographs
 - Bite wing radiographs
 - Occlusal radiographs
 - Panoramic radiographs
7. Special Technique for the Handicapped Child
8. Hand Wrist Radiographs
9. Magnetic Resonance Imaging
10. Digital Radiography
11. Dental Xeroradiography
12. Radiation Protection



INTRODUCTION

Radiographs act as an important diagnostic tool in the treatment of children. Early diagnosis of caries can avoid children experiencing dental pain and extraction. Developmental problems related to eruptive abnormalities or associated with growth can be identified with the use of radiographs and early management of these problems may reduce the need for prolonged orthodontic procedures in the later life.

Selection of the appropriate radiograph for the child patient depends on the age of the child, the size of the oral cavity and the level of patient cooperation. Ideal technique should expose the patient to a minimum amount of radiation, require as few radiographs as possible, take as little time as possible and provide an adequate examination of the dentition and supporting structures.

POINTS TO BE CONSIDERED BEFORE PLANNING FOR RADIOGRAPHS

- Avoiding retakes by obtaining the previous radiographic history, following the appropriate guidelines for the correct size, number and type of film used, all area to be radiographed should be included within the film borders, avoiding cone cut, overlapping, elongation, shortening and correctly processing the film.
- Radiographs should be an adjunct for clinical examination and should not replace full mouth clinical examination.
- Determination of appropriate number and size of films required to take radiographs of the particular region and unnecessarily not the whole mouth.
- Placement of lead apron and thyroid collar on the patient and parent.

Components of X-ray machine (Fig. 20.1)

1. The X-ray tube head and the positioning device.

The tube head consists of:

- A. The cathode which serves as a source of electrons. It consists of a filament and a focusing cup. The focusing cup directs the electrons generated by the filament to the focal spot (spot on the target).

- B. The anode or the target at which the beam of high speed electrons is directed. It is composed of tungsten target and copper stem. It helps to convert the kinetic energy of the electrons into X-ray photons.

The positioning device is used to position the tube head in correct position while taking the radiographs.

2. Power Supply:

The primary function of power supply is:

- A. To provide a current to heat the X-ray tube filament (achieved by an step down transformer).
- B. To create a potential difference between the anode and cathode (achieved by an high voltage transformer).

3. Timer:

It is a timing device. It controls the X-ray production time by controlling the time that the high voltage is applied to the tube.



Fig. 20.1: Dental X-ray machine: A: Positioning Device; B: Tube head; C: Control panel or the timer

An IOPA film packet consists of (Fig. 20.2)- From the side facing the X-ray tube

1. Outer wrapper made of plastic material
2. A black paper on either side of the film protects it from light
3. Film
4. A thin sheet of lead foil placed behind the film prevents residual radiation passing beyond the film and prevents back scatter radiation



Fig. 20.2: Components of IOPA film packet: A. Outer plastic wrapper; B. Black paper; C. Film; D. Lead foil

For young children, where movement during filming is a problem, the need for short exposure time is a first priority. When exposure time is shortened, compensation must be made in terms of increased mA or kVp. If mA cannot be increased then it is necessary to use high kVp.

Factors affecting radiographic quality:

Quality of the radiograph depends upon the density, contrast, sharpness, distortion and speed.

i) Density:

The density of a radiograph is a measure of its blackness. It is determined by the amount of radiation reaching the film and the sensitivity of the film to radiation. Factors that affect film density are

- Exposure- Increasing milliamperage(mA), Operating voltage, kVp or time of exposure will increase the density.
- Subject thickness- The thicker the object the more attenuation of the beam is seen.
- Object density: Greater the density of an object, or an area within the object, the greater is the attenuation of the X-ray beam directed through the object or area.
- Film speed
- Source-to-film distance.

ii) Contrast:

It is defined as the difference in densities between various regions on Film. A film has high contrast if the radiolucent portions are quite black and the radiopaque lesions are very white. Factors determining level of film contrast include:

- Tube voltage: Increased kVp decreases film contrast. The X-rays produced at higher tube voltage have greater penetrating power. Selection of kilovoltage depends on the age of patient.
- Film contrast capability (built in by manufacturer)
- Film-processing technique.

iii) Distortion:

Variations in distortion include;

- True (Proportional) enlargement
- Elongation or foreshortening
- Superimposition
- Overlapping of structures

iv) Sharpness:

Factors important in obtaining a sharp image are:

- Small X-ray source
- Appropriate source object - film distances.
- Lack of motion of cone, patient or films during exposure.

v) Speed:

Speed refers to the amount of radiation required to produce a radiographic film of standard density. The speed of a dental X-ray film is indicated by letter designating its speed group. Only films with speed D or E are indicated for intraoral radiography. A fast film relatively requires a low exposure.

General recommendations for radiologic dental examination of children

- Exposure should be made only after taking a history and completing clinical examination and should be to supplement and not substitute for this clinical examination. If the child is a new patient but has been earlier seen by another dentist then access to, or copies of previous radiographs should be sought.
- X-ray equipment and darkroom procedures should be well controlled to minimize unnecessary radiation and poor quality processing.
- Fast film and rectangular collimation should be used. Correct size and number of films should be used.
- Long cone technique with a 70-90 kVp is encouraged wherever possible. If a child does not tolerate film



holders in the mouth, then the bisecting angle technique may be used.

- 5) Operators should be well trained to minimize the likelihood of unnecessary retakes.
- 6) Lead apron and thyroid collars must be used.

Factors controlling X-ray beam:

i) Tube voltage:

Tube voltage is measured in kVp. As the kVp increases it results in an increased efficiency of conversion of electron energy into X-ray photons. High energy X-ray photons (short wavelength) are preferred as they have a greater probability of penetrating matter.

ii) Exposure time:

When the time of exposure is doubled the number of photons generated is doubled, but the range of photon energies is unchanged. Thus, the effect of increasing the exposure time helps to increase the number of photons that are generated and thus to control the “quantity” of the exposure.

iii) Tube Current:

There is a linear relationship between tube current and tube output. Thus, doubling the tube current should double the number of photons produced.

iv) Filtration:

Out of the X-ray photons of different energy levels only those with sufficient energy to penetrate anatomic structures are useful for diagnostic radiology. Photons with low penetrating powers (long wavelength) contribute only to the patient exposure and not for the quality of the film. Low power photons are removed for the safety of the patients by placing aluminium filter in the path of beam.

v) Collimation:

When X-ray beam is directed at a patient, only about 10% pass through as the information carrying beam and are available to form an image on a film whereas 90% of the X-ray photons are absorbed by the tissues and generate scattered radiation within the exposed tissues. They also tend to fog the film and degrade the image. The detrimental effect of scattered radiation on the formation of image can be minimized by reducing amount of scattered radiation formed and by preventing this radiation from reaching the film through collimation. Collimation reduces the size of X-ray beam and thus the volume of irradiated tissue. Diaphragm, tubular and rectangular collimation are used in dentistry.

GUIDELINES FOR PRESCRIBING RADIOGRAPHS

It depends on the following criterias.

Evaluation of the Development of Dentition

This can be done by observing the radiographs for the following

- A. Stages of development, eruption and exfoliation of teeth
- B. Amount of root formation
- C. Physiologic root resorption
- D. Amount of bone over the erupting tooth
- E. Degree of pulp maturity.

Pathologic Evaluation

It includes

- A. Caries detection
- B. Evaluation of traumatic injuries
- C. Degree of pulp involvement such as proximity of caries to pulp horn, internal resorption or calcific degeneration
- D. Evaluation of periodontal health by observing thickness of periodontal ligament, furcation involvement, bone loss, external resorption etc.

Detection of Developmental Anomalies

Commonly observed anomalies are

- A. Widely divergent roots
- B. Sharply curved pulp canals
- C. Alterations in the number and length of roots
- D. Ectopically positioned teeth
- E. Ankylosis
- F. Supernumerary teeth
- G. Congenitally missing teeth
- H. Malformed teeth such as microdontia, macrodontia, dens in dente, taurodontism, gemination, fusion, root dilacerations etc.

Post-treatment Evaluation

It is done to evaluate

- A. Accuracy of treatment
- B. Type and success of pulp treatment
- C. Post-surgical healing
- D. Treatment failure



Routine Evaluation based on Risk Assessment

Low Risk Child

Healthy, asymptomatic patient (no evidence of caries, trauma, anomalies or malocclusion), exposed to optimum levels of fluoride, performing daily preventive technique, consuming a diet with few exposures to retentive carbohydrates between meals

- With closed proximal contact: Bite wing radiograph is taken on the first visit and when there are no caries, radiograph may be taken once a year for early intervention.
- With open proximal contact: Radiographs may be taken once in two years.

High Risk Child

- Radiographs are taken more often as twice a year.

Radiographs taken for routine evaluation

Age (years)	Consideration	Radiograph
3-5	Nothing Abnormal	None
	- open contact	None
	- Closed contact	4 film survey
	Extensive caries	4 film survey +
	Deep caries	IOPA of selected tooth
6-7	Nothing Abnormal	8 film survey
	Extensive caries, deep caries	8 film survey+ IOPA of selected tooth
8-9	-do-	12 film survey
10-12	-do-	12 or 16 film survey

Film surveys:

- 4 film -2 anterior occlusal+ 2 bite wing
- 8 film -4 posterior IOPA +2 anterior occlusal+2 bite wing
- 12 film- 4 posterior IOPA + 4 canine IOPA + 2 incisor IOPA +2 bite wing
- 16 film- 12 film survey +4 permanent molar radiograph

bringing the X-ray tube near the parents face or a doll's face first, helps to dispel any fear the child may have). Modelling behavior management technique will also help reduce fear. Parents or siblings can play the role of a model. Children are also more willing or cooperative if they know that they are required to hold the film in the mouth for a limited period of time.

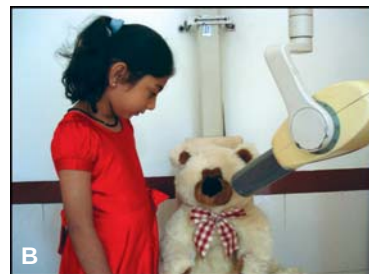


Fig. 20.3: Tell Show Do (TSD) technique for preparing the child to be radiographed: A: The child is explained and the X-ray machine is compared to a camera; B: The X-ray tube is placed near doll's mouth; C: The X-ray is taken once the child is cooperative and ready

Tips to assist radiographic process

- Dampen the film, as it removes the taste of the packet
- Do not insert the film directly but take it horizontally and then slowly rotate it into vertical position (Fig. 20.4)
- Before inserting, curve the film slightly so that it will not impinge on the tissues.

CHILD PREPARATION AND MANAGEMENT (FIG. 20.3)

Taking a radiograph may be the child's first dental experience. So it has to be made as pleasant as possible. Euphemisms should be used with TSD technique. (By

METHODS OF REDUCING RADIATION EXPOSURE

- Wearing lead apron and thyroid collar (Fig. 20.5)
- Use of faster speed film (F speed film)



Fig. 20.4: Take the film horizontally and then rotate it to vertical direction



Fig. 20.5: Lead apron and thyroid collar (Arrow) in one unit

- Panoramic radiography uses film screen combinations that have reduced exposure time
- Long rectangular collimator reduces the area unnecessarily exposed to radiation by almost 4 square inches compared to a round collimator

- Use of higher kilovolt peak (KVP) technique reduces patient exposure
- Good dark room procedures, thus avoiding retakes.

Intraoral film size (Fig. 20.6):

Size 0- Used for bite wing and IOPA of small children

Size 1- Used for anterior teeth in adults

Size 2- Standard film, used for anterior occlusal, IOPA and bite wing in mixed and permanent dentition

Occlusal films - $57 \times 76\text{mm}$ used for maxillary or mandibular occlusal radiographs

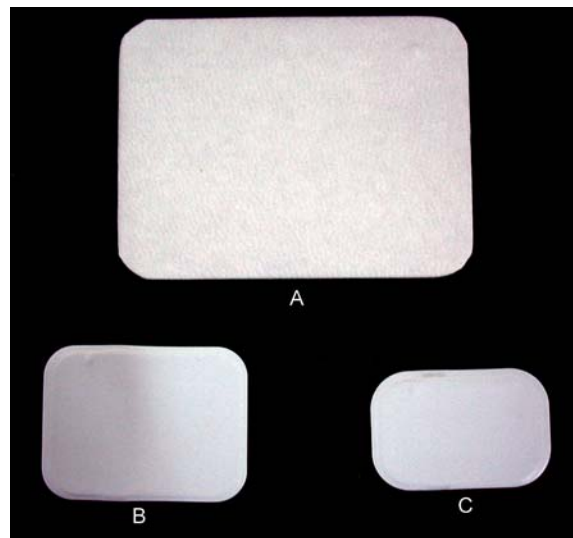


Fig. 20.6: Films of different sizes: A: Occlusal film; B: Adult or standard film; C: Pedodontic film

RADIOGRAPHIC TECHNIQUES COMMONLY USED IN CHILDREN

1. Intraoral
 - IOPA
 - Bite wing
 - Occlusal
 - Panoramic
2. Extraoral
 - TMJ and lateral oblique view (film size is 1.5×7 inches)
 - Lateral cephalograms, PNS view (film size is 8×10 inches)
 - Orthopantomography (film size is 6×12 inches)



Composition of X-ray film

1. Base: polyester, polyethylene terephthalate
2. Adhesive layer: attaches film emulsion to film base
3. Film emulsion: it is the image receptor system.
It consists of silver bromide crystals with some amount of silver iodide
4. A protective layer of clear gelatin to shield the emulsion from mechanical damage

Intraoral Periapical (IOPA) Radiographs

Indications (Fig. 20.7)

1. To evaluate the development of the root end and to study the periapical tissue
2. To detect alterations in the integrity of the periodontal membrane
3. To evaluate the prognosis of the pulp treatment by observing the health of the periapical tissues
4. To identify the stage of development of unerupted teeth
5. To detect developmental abnormalities like supernumerary, missing or malformed teeth
6. For early detection of pathologic changes associated with teeth
7. For space analysis in the mixed dentition
8. To assess the path of eruption of permanent teeth
9. To evaluate the extent of traumatic injuries to the root and alveolus

Loss of cancellous bone is undetectable until at least 6.6% of the mineral content of the cortical bone in the direct path of the X-ray beam has been lost. Hence a periapical lesion is usually larger than its radiographic image

Techniques for taking IOPA:

Two techniques are recommended for taking IOPA projections. They are

1. The paralleling technique (Fig. 20.8A)
 2. The bisecting angle technique (Fig. 20.8B)
- i. *The paralleling technique* - The film is positioned in the mouth using extension cone parallel (XCP) instruments (Fig 20.9) or precision film holders such that the film is held parallel to the long axis of the

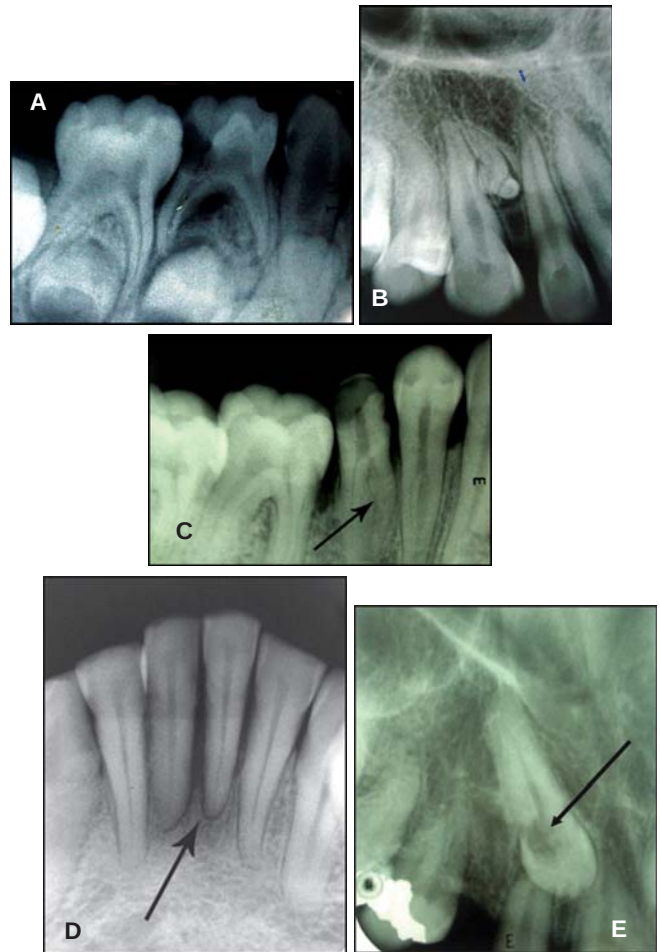


Fig. 20.7: Some of the Indications of IOPA: A: Evaluate the extension of caries; B: Odontome; C: Bifid Premolar root; D: Pathologic root resorption of lower central incisors; E: Pre-eruptive caries

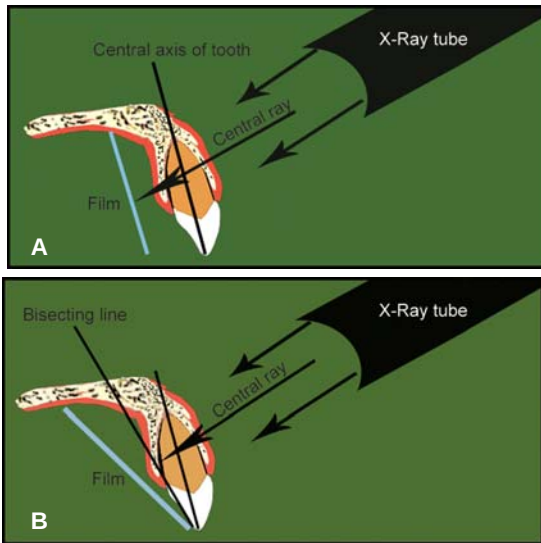
tooth to be radiographed. The X-ray tube head is aimed at right angles to the tooth and the film

Advantage:

- Little magnification
- Periodontal bone level are well represented
- Radiographs are accurately reproducible by different operators

Disadvantage:

- Difficult to position the film
- May not be possible to place the film in shallow palates



Figs 20.8: Diagrammatic representation of the film and X-ray tube position: A: Paralleling technique; B: Bisecting angle technique

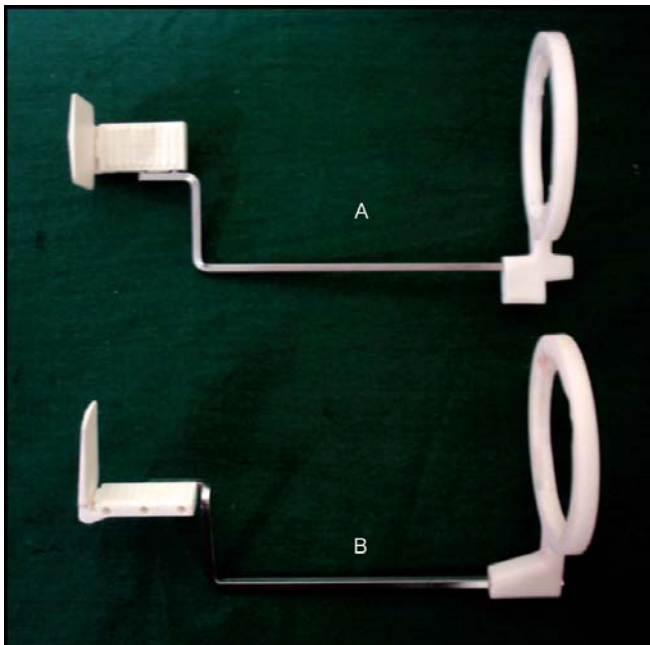


Fig. 20.9: XCP instrument: A: For posterior teeth; B: For anterior teeth

- Apex of the root usually appear at the edge of the film, thus periapical region is not covered adequately
- Increased radiation exposure

- The bisecting angle technique* – The film is placed close to the tooth to be radiographed using snap a ray film holder (Fig. 20.10) or hemostat (endoray film holder (Fig. 20.11) if endodontic instruments are placed in the tooth). The X-ray tube is adjusted such that the central ray of the X-ray bisects the angle formed between the long axis of the film and the tooth.

Advantage:

- Film positioning is easy and comfortable for the patient
- If positioned based on correct angulations, the image size does not alter

Disadvantage:

- Variables are many in this technique making it difficult to reproduce accurately every time
- Incorrect vertical angulation results in elongation of the image and incorrect horizontal angulation results in overlapping of the images of the crown and root or cone cut
- Periodontal bone level are not clear
- Detection of proximal caries is difficult



Fig. 20.10: Snap A ray film holder. It has two ends for Posterior (A) and Anterior (B) teeth

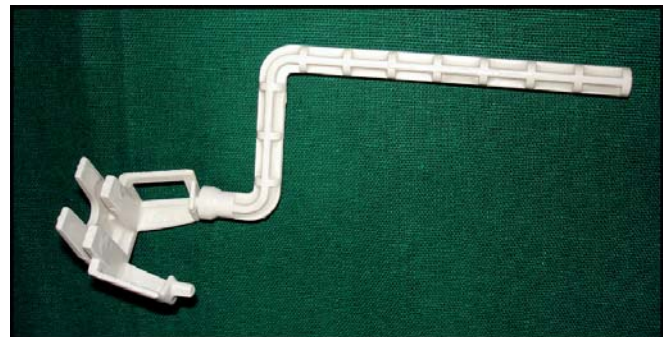


Fig. 20.11: Endoray film holder



Gagging in children is common while placing the film in the mouth. Some of the common remedies are:

1. Distract the child by asking to count numbers, alternately moving the right and left leg, etc
2. Patient can suck a topical anesthetic lozenge
3. Wetting the Polythene (film packet)
4. Never mention to relax tongue
5. Never slide the film along the palate or tongue
6. Advise patient to breathe rapidly through nose

Procedure steps:

- *Behavior management:* Tell Show Do technique is used to obtain the cooperation of the patient.
- *Maxillary teeth (Fig. 20.12):* Head of the patient is upright. The film is positioned on the palatal aspect of the teeth by using film holders. The tooth in question will occupy center of the film. The X-ray cone is kept at the correct angulation and the central X-ray beam is directed perpendicular to the film while using long cone technique. When bisecting angle technique is used the central beam is directed perpendicular to an imaginary bisector that bisects the angle formed by the long axis of the tooth and the film.
- *Mandibular teeth (Fig. 20.13):* The film is kept on the floor of the mouth, on the lingual side. The tooth in question will occupy center of the film. The X-ray cone is kept at the correct angulation and the central X-ray beam is directed perpendicular to the film while using long cone technique. When bisecting angle technique is used the central beam is directed perpendicular to an imaginary bisector that bisects the angle formed by the long axis of the tooth and the film.

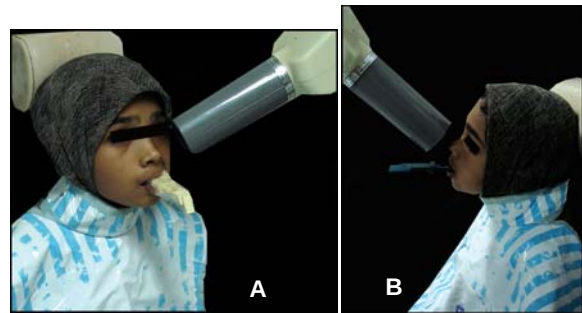
Angulations used for IOPA projections (White and Pharoah):

	Maxilla	Mandible
Anterior teeth	+40	-15
Canines	+ 45	-20
Premolars	+30	-10
Molars	+20	- 5

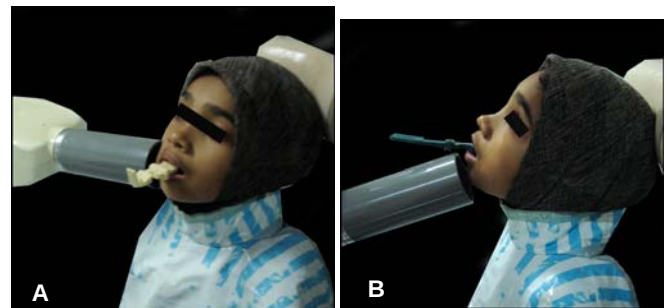
Bite Wing Radiographs

Indications (Fig. 20.14)

- Early detection of incipient inter-proximal caries
- To understand the configuration of the pulp chamber



Figs 20.12A and B: Recording the X-ray for maxillary teeth: A: Posterior teeth; B: Anterior teeth



Figs 20.13A and B: Recording the X-ray for mandibular teeth: A: Posterior teeth; B: Anterior teeth

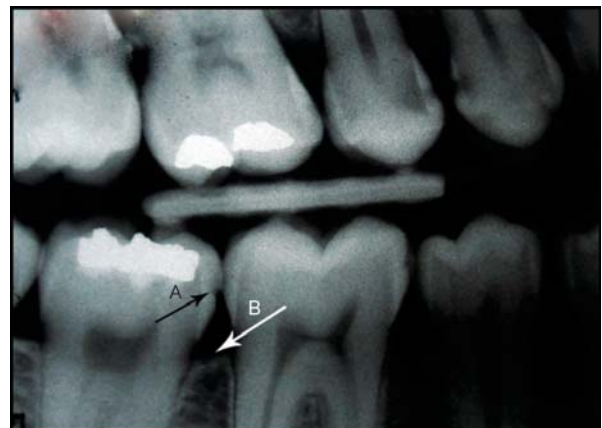


Fig. 20.14: Indications of bite wing radiograph: A: Interproximal caries detection; B: Evaluate the interdental bone

- Record the width of spaces created by premature loss of deciduous teeth
- Determine the presence or absence of premolar teeth
- To determine the relation of a tooth to the occlusal plane for possibility of tooth Ankylosis



- Detect levels of periodontal bone at the interdental area
- Detect secondary caries

Technique: The head is positioned such that the midsagittal plane is perpendicular and the ala-tragus line is parallel to the floor. The lower edge of the film is placed in the floor of the mouth between the tongue and the lingual aspect of the mandible and the bite tab is placed on the occlusal surfaces of the mandibular teeth. The film is positioned to cover all the region of concern. The central ray enters at the occlusal plane at a point below the pupil, vertical angle being +8 degrees. A tab or bite platform or Unibite film holders can be used to position the film parallel to the occlusal plane (Fig. 20.15).



Figs 20.15A and B: Obtaining a bite wing radiograph: A. Film holder used for recording bite wing radiograph; B. Film and X-ray tube in position

Occlusal Radiograph

Indications (Fig. 20.16):

- Determine the presence, shape and position of midline supernumerary teeth



Fig. 20.16: Palatal cyst can be easily diagnosed in an occlusal radiograph

- Determine impaction of canines
- Determine the presence or absence of incisors
- Assess the extent of trauma to teeth and anterior segments of the arches
- In case of trismus and trauma, where the patient cannot open the mouth completely
- Determine the medial and lateral extent of cysts and tumors.

Technique (Fig. 20.17): Occlusal radiographs can be either maxilla or mandible.

Maxillary and mandibular occlusal radiographs can be of 3 types-

1. Anterior topographic view
2. Cross sectional view
3. Lateral topographic view
 - i. **Maxillary Anterior topographic radiograph:** Maxillary anterior topographic radiograph is indicated to view anterior maxilla and its dentition. While taking the radiograph the patient's head is adjusted so that the occlusal plane is horizontal to the floor. The film is placed crosswise in the mouth with exposure side towards maxilla and the posterior border touching the rami horizontally. The patient is asked to close the mouth gently. Central ray is directed through the tip of the nose toward the middle of the film with approximately +45 degrees vertical angulation and 0 degrees horizontal angulation.

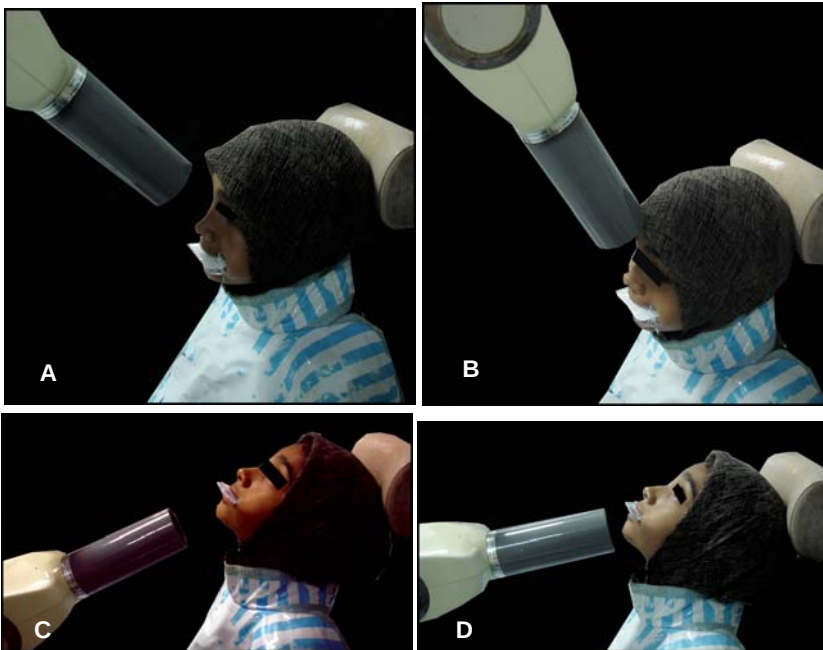


Fig. 20.17: Obtaining an occlusal radiograph: A: Maxillary Anterior topographic radiograph; B: Maxillary Cross sectional radiograph; C: Mandibular cross sectional radiograph; D: Mandibular anterior topographic radiograph

- ii. *Maxillary Cross sectional view:* Maxillary cross sectional view shows palate, zygomatic process of maxilla, nasolacrimal canals, antero-inferior aspects of antrum and nasal septum. The patient's head is adjusted so that the occlusal plane is horizontal to the floor. The film is placed in the mouth crosswise with exposure side towards maxilla and the posterior border touching the rami horizontally. The patient is asked to close his mouth gently. The central ray is directed at a vertical angulation of $+65^\circ$ and a horizontal angulation of 0° towards the bridge of the nose just below the nasion, towards the middle of the film.
- iii. *Maxillary Lateral topographic view:* Maxillary lateral topographic view shows a quadrant of the alveolar ridge of the maxilla, tuberosity, infero lateral aspect of antrum, zygomatic process of maxilla. Here the film is placed with its long axis parallel to the sagittal plane on the side of interest till the film touches the ramus of that side. The lateral border of film is positioned parallel to the buccal surfaces of the posterior teeth, extending 1cm laterally behind the buccal cusps. The patient is asked to close and gently hold the film in position. Central ray is projected with a vertical angulation of $+60^\circ$ to a point 2cm below the lateral canthus of the eye, directed towards the center of the film.
- iv. *Mandibular anterior topographic view:* Mandibular anterior topographic occlusal view includes the anterior portion of the mandible and inferior cortical border of the mandible. The film placement is similar to maxillary occlusal (exposure side towards mandible) and the head is placed so that the occlusal plane is at -45° to the floor and central ray has -10° degree vertical angulation and is directed through the chin towards the middle of the film.
- v. *Mandibular cross sectional view:* Mandibular cross sectional view includes soft tissues of the floor of the mouth, lingual and buccal cortical plates of the mandible from second molar to second molar. The patient is seated in a semi reclining position with the head tilted back so that the ala-tragal line is almost perpendicular to the floor. The film is placed in the mouth as described for mandibular cross sectional view. The anterior border of the film should be approximately 1 cm beyond the mandibular central incisors. The central ray is directed at the midline through the floor of the mouth approximately 3 cm below the chin, at right angles to the center of the film.



- vi. *Mandibular Lateral topographic view:* Mandibular lateral topographic view covers half the floor of the mouth, buccal and lingual cortical plates of half the mandible and teeth. The patient position is same as mandibular anterior topographic occlusal view. Film is placed with its long axis placed parallel to the sagittal plane and 1 cm laterally to the buccal surfaces of the teeth. The central ray is directed perpendicular to the center of the film through a point beneath the chin approximately 3 cm posterior to the point of the chin and 3 cm lateral to the midline.

Panoramic Radiographs (Figs 20.18 and 20.19)

1. It is an extra oral radiograph in which the X-ray film and the X-ray source move in opposite directions.
2. It can be used to visualize the entire dentition.
3. This reduces the total number of films and thus reduces the radiation exposures.
4. This can also be used to introduce the child to radiography as it is an extraoral radiograph.
5. It requires a total of 15 to 22 seconds to record.
6. Although it is considered as a supplement it cannot substitute intraoral radiographs in the diagnosis of caries or for viewing the periapical region.
7. This view can be useful in handicapped children and for viewing a wide area of the TMJ and associated region.



Fig. 20.18: Panoramic radiographic machine

Commonly used Localization techniques

1. Clark's technique

The purpose is to locate or determine the buccolingual relationship of impacted tooth or foreign body within the alveolar process relative to erupted teeth in the maxilla.

The rationale is that when shadows of two objects of equal size are projected in a straight line with each other and the observer, the shadow of the more distant object will be obscured from the observers view by shadow of the near object. On moving to the right, the shadow of the far object also moves to the right i.e. in the direction the observer moves. Similarly, if the observer moves to the left, the object moves to the left. In each case the shadow of the near object will appear to move in a direction away from (opposite to) the observer movement.

Procedure: Two radiographs of the same area are required. Radiograph 1 utilizes normal, standard radiographic procedure relative to placement and tube alignment for vertical and horizontal angulation. Radiograph 2 utilizes exactly same placement and vertical angulation as in radiograph 1. The only difference is that the horizontal angulation of the central ray is altered to a more exaggerated mesial direction.

The localization is accomplished through the use of buccal object rule which states that an object buccal to its adjacent structures will appear to move in a direction opposite the moving X-ray source, on the other hand an object lying lingual to its adjacent structures will appear to move in the same direction as moving X-ray source.

2. Miller' technique

The rationale for this procedure is that in order to locate an object in space relative to another object it is necessary to take a minimum of two observations from different positions, 90° apart. This can usually be accomplished by observing directly from the side and then viewing the object from the top or bottom.

Procedure: Two radiographs are utilized for this technique. Radiograph 1 is standard periapical radiograph utilizing the paralleling principle. This demonstrates the superior - inferior relationship of the impacted object to the adjacent teeth and alveolar crest. Radiograph 2 is a standard cross-section occlusal radiograph taken 90° to the first film. This radiograph subsequently demonstrates the buccal-lingual relationship of impacted object to the teeth and buccal and lingual cortical plates of mandible.

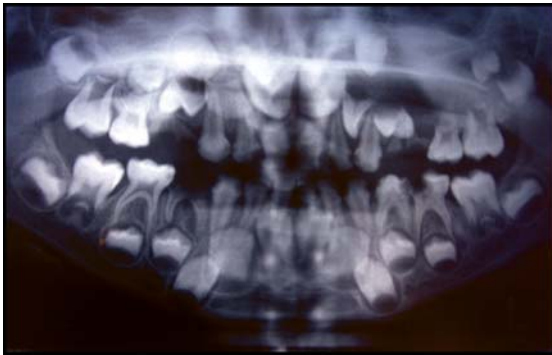


Fig. 20.19: Panoramic radiograph

SPECIAL TECHNIQUE FOR THE HANDICAPPED CHILD

The physically handicapped child cannot usually hold a film in his/her mouth with fingers. In such a child radiograph can be taken by the parent holding the child or by the use of film holding devices. If the child is unable to open the mouth, extraoral radiographs such as panoramic view, lateral jaw projections, anterior occlusal screening, should be preferred.

Children are at higher risk for radiation exposures than adults. The reasons are-

- Tissues are in growth period, so more sensitive to radiation.
- Children have longer life span with greater susceptibility to tumors
- Effects of radiation are cumulative
- Because of their small stature, children are closer to the central X-ray beam
- Because of increased caries, children might require more number of radiographs

HAND WRIST RADIOGRAPHS (FIGS 20.20 AND 20.21)

- Estimates the skeletal age.
- Carpal bones, epiphysis, phalanges, metacarpals provide a clue to bone growth in the body as a whole
- Ossification occurs in these bones after birth and before maturity.
- Carpal bones ossify at different ages beginning from Capitate (3rd month), Hamate (4th month), Triquetral (3rd year), Lunate (4th year), Trapezoid and Scaphoid (5th year), Trapezium (6th year) and lastly Pisiform (12th year).

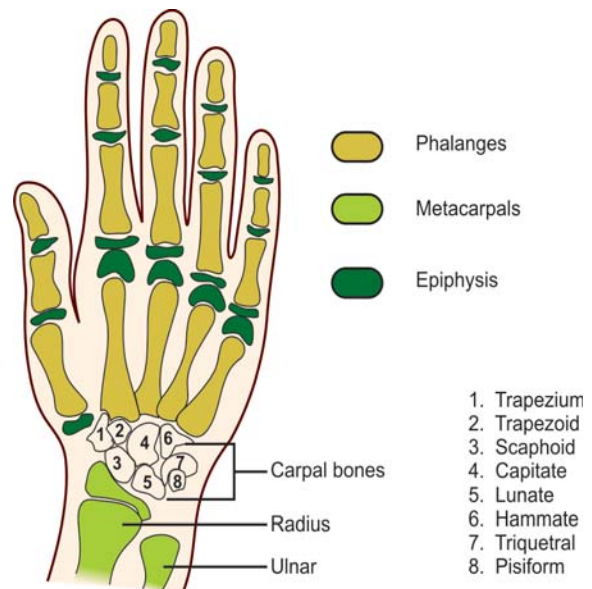


Fig. 20.20: Diagrammatic representation of hand wrist radiograph

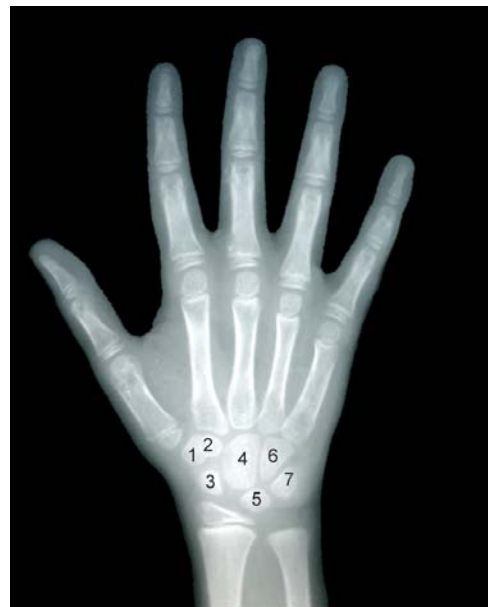


Fig. 20.21: Hand wrist radiograph of a 8 year-old-child. Note the missing pisiform bone as it begins to calcify at 12 years of age

- The radiographs are inspected to assess the growth by evaluating the shape of the carpal bones, degree



of ossification of the skeleton, time and order of appearance of carpals

Indications of Hand Wrist Radiograph

- Prior to rapid maxillary expansion- to assess the stage of growth
- When maxillomandibular changes are indicated in the treatment of Class III, skeletal Class II or skeletal open bite cases.
- Patients with marked discrepancy between dental and chronologic age
- Orthodontic patients requiring orthognathic surgery if undertaken between the ages of 16 and 20 years.

Hand wrist X-ray can be correlated to

1. Dental development
2. Peak height velocity
3. Cervical vertebrae
4. Cranial base outline
5. Spheno occipital synchondrosis

The stage of mineralization of the carpal bones are determined. Then the development of metacarpal bones and phalanges are evaluated. Standard tables and analysis of Bjork are useful which divides the maturation process of bones of the hand between the 9th to 17th year into eight developmental stages.

MRI: MAGNETIC RESONANCE IMAGING (FIG. 20.22)

It is a non-invasive technique in which high strength, static magnetic field pulsed radio waves and switched gradient magnetic fields are used to create an image. It is widely used to image the soft tissue pathologies of head and neck region.

Paranasal sinus view: It is also called as water's view, indicated for visualization of paranasal air sinus.
Reverse-Town view: mainly indicated for TMJ visualization
Submentovortex view: for viewing condyles, sphenoid sinus and curvature of the mandible
RVG, RadioVisioGraphy: the image is recorded as a digital image and requires a computer. The image obtained can be modified by increasing or decreasing the brightness or contrast.



Fig. 20.22: MRI image of the head

DIGITAL RADIOGRAPHY OR REAL-TIME IMAGING (FIG. 20.23)

To obtain digital images, image receptors like CCD (charged coupled device), CMOS (complementary metal oxide semiconductors) and PSP (photostimulable phosphor plates) can be used. The digital imaging system eliminates the hazardous chemical wastes like processing solutions, lead foil etc. Images can be electronically transferred to other health care providers thus helping in telemedicine. In addition, digital receptors require less radiation than the films, thus lowering the patient absorbed dose.

Advantages

- Lower dose of radiation required
- Computer manipulation of the image such as alteration in contrast, resolution, image enhancement is possible
- Automated image analysis
- No need for conventional processing, thus avoiding all processing film faults and the hazards associated with handling the chemical solutions.
- Storage and archiving of patient information is easier
- Transference of images between institutions (Teleradiology) is possible.



Disadvantages

- Expensive, especially panoramic systems
- Large disc space required to store the images
- The sensor and the computer have to be connected directly, and the connecting cable can make intraoral placement of the sensor difficult.
- There can be some loss of image definition and resolution compared with film, both on the TV monitor and on the hard copy print out.
- Image manipulation can be time consuming and misleading to the inexperienced.
- It is difficult with some intraoral systems to view multiple images at once as in a full mouth survey.
- The hard copy images may fade with time - this may be a major problem in pediatric practice, since a radiograph taken of a 6 year old child legally should be kept until the patient has reached adulthood.



Fig. 20.23: Digital radiograph

DENTAL XERORADIOGRAPHY

Xeroradiography is a technique which uses the xerographic copying process to produce images generated from standard diagnostic X-rays. Xeroradiography has been successfully used in medical field. This system employs a standard dental radiographic unit as the source of irradiation. Exposure settings are the same as those for conventional radiography (70 to 100 kVp and 10 to 15 mA), except that the exposure time is reduced. Xeroradiography employs a charged metal plate within a small plastic intraoral cassette. This cassette is about the

size of standard No.2 radiographic packet. During exposure those portions of the plate struck by the X-ray beam are discharged in proportion to the amount of energy striking the plate and a latent image is formed.

Advantages

1. Resolution - Ability to distinctly record separate images of small objects that are placed close together.
2. Latitude - Xeroradiography has a wider latitude of exposure.
3. Edge enhancement: The advantages of resolution and latitude are a result of a special capability of xeroradiography known as edge enhancement in which the boundary is accentuated between two adjacent structures only slightly different in density.
4. The ability of xeroradiographs to display fine structural detail and a wide range of tissue densities.
5. Xeroradiographic images show both supragingival and subgingival calculus in much greater detail.
6. Amalgam and gold restorations are entirely radio-opaque whereas porcelain and plastic restorations are more radiolucent. Base materials are readily distinguished from amalgam or gold.

RADIATION PROTECTION OR RADIATION HYGIENE MEASURES

Abiding with the rules and regulation such as the Health and Safety at work act which says that every practice resulting in an exposure to ionizing radiation shall be justified by the advantages it produces, All exposures shall be kept as low as reasonably achievable (ALARA principle) and the sum of doses and committed dose received shall not exceed certain limits.

The main purpose of radiation hygiene measures are to minimize the radiation exposure to the patient and the operator. The recommendations are

1. *Maintaining good equipment standards:* Dental radiographic equipment should be in compliance with federal and state standards and the equipment should be inspected by a person trained in radiation protection at installation, modification and at atleast five year interval.



2. *Obtaining previous radiographs:* A thorough history of previous exposures of all children should be obtained, dentists should share existing radiographs with any other dentist when it would benefit the patient.
3. *Correct exposure time:* An accurate timer is essential to produce consistent quality diagnostic radiographs with minimal exposure to patient.
4. *Filtering of X-ray beam:* Use of aluminum filters in the X-ray tube head to absorb selectively long wavelength, poorly penetrating X-rays that are not useful in producing the radiographic image.
5. *Right type of cone to be used:* Open end, lead lined cylinders or rectangular cones are preferred. Pointed plastic cones are not recommended because they increase scattered radiation to all areas of the patients head, neck and reproductive organ.
6. *Restricted beam of radiation:* The beam of radiation should be restricted or collimated (Fig. 20.24) no larger than 7 cm (2 3/4 inches) in diameter when measured at the patients skin or 2 1/2 inches at the end of the cone. It is useless and destructive to irradiate tissues beyond the region of radiographic interest. Collimation restricts the size of the beam so that coverage is limited to the area around the intraoral film. Rectangular field of the film is preferable to a circular field of radiation because a smaller area of the patients face is irradiated with each exposure.
7. *Protective shielding:* The ADA recommends the use of protective shields for all patients with reproductive potential. With children, the short head-to-gonad distance and increased biological sensitivity to radiation, and use of primarily vertical cone orientation for anterior projections provide sufficient indications for use of gonadal shielding. Irradiation of thyroid may be significantly reduced by protecting the child with a lead impregnated collar.
8. *Film Holding Devices:* Film holding devices are recommended because they increase the stability of the film during intraoral radiographic procedures and they eliminate the need for the patient to hold the film in their mouth with fingers.
9. *Correct film processing procedures:*
These procedures includes
 - a. Dark room free from light leaks



Fig. 20.24: Round collimator lined by lead (Arrow) that restricts the size of the X-ray beam

- b. Adequate darkroom safe lighting
 - c. Time temperature processing.
10. *Radiation protection of operator and office personnels:* Office personnel deserve to work in an environment that is free from the potential risk of unnecessary radiation exposure. The procedures that ensures a healthful radiation environment are:
 - A. Monitor office personnel: Subscribing to one of the many film badge services provides an excellent tangible way for the practitioner to express concern for reducing and monitoring radiation to office personnel.
 - B. Establish radiation safety procedure. The most effective way of reducing - operator exposure to X-radiation is to enforce strict application of position and distance rule, that is, stand at least 6 feet away from the patient at an angle between 90° and 135° to Primary beam. If the operator cannot stand atleast 6 feet away from patient during exposure they should stand behind an



appropriate protective barrier. Appropriate barriers includes brick wall with lead lined paneling on gypsum wall board.

- C. Films should never be held in place by operator in the patients mouth.
- D. Operator should never hold or stabilize the tube head or cone during the exposure.
- E. The operator should never stand directly in line with primary beam of radiation

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Chapter 21



Oral Surgical Considerations in Children

1. Introduction
2. Neurologic Anatomy
3. Topical Anesthesia
4. Local Anesthesia:
 - Composition of local anesthetic solution
 - Classification of local anesthetic solution
 - Anesthetic agents suitable for children
 - Ideal requirements of the anesthetic agent
 - Potency of the anesthetic agent
 - Mode of action of local anesthesia
 - Absorption, metabolism and excretion of anesthetic agent
 - Duration of action of the anesthetic agent
 - Complications following local anesthetic administration
5. Contraindication for local anesthetic administration
6. Onset and duration of action of anaesthesia
7. Factors responsible for success of local anesthesia
5. Differences between the Child and the Adult
6. Types of Injection Procedures
7. Anesthesia for Maxillary and Mandibular Tissues
8. Commonly Made Mistakes
9. Extraction of Teeth
 - Rationale for deciduous tooth removal
 - Contraindications to tooth removal
 - Position of the operator and the Patient
10. Analgesics and Antibiotics used in pediatric Dentistry



INTRODUCTION

Extraction of tooth is one of the simple yet most complex procedures done on a pediatric patient. It requires extra effort for management of the child apart from the skills required for performing the procedure.

Most of the minor surgical procedures like extraction, or abscess drainage are performed under local anesthesia. In a very young child (< 3 yrs) or an extremely unmanageable child, procedures might have to be performed under general anesthesia, due to lack of cooperation.

Understanding the normal anatomy of the specific area, the medicament used for anesthesia and associated problems are very important before planning any procedure.

NEUROLOGIC ANATOMY

Innervation to the Primary and Permanent Teeth

The maxillary and mandibular nerves derived from trigeminal nerve provide the main innervation for maxilla, mandible and adjoining tissues.

The terminal branches of Maxillary Nerve are:

1. Superior alveolar nerves
2. Greater (Anterior) palatine and Nasopalatine nerves

The terminal branches of Mandibular Nerve are:

1. Inferior Alveolar Nerve
2. Mental and Incisive Nerve
3. Long buccal Nerve

Terminal Branches of Maxillary Nerve

Superior Alveolar Branches (Fig. 21.1)

They further branch into Posterior, middle and anterior branches. The posterior superior alveolar nerve branch, supplies the buccal mucosa and the mucous membrane of the cheek, posterolateral wall of the maxillary sinus and the supporting structures of the three permanent molars and their root ends with the exception of the mesiobuccal root of the permanent first molar.

The middle superior alveolar nerve innervates the epithelial surface of the sinus and the root ends and supporting structures of the primary first and second

molars or permanent first and second premolars and the mesiobuccal root of the permanent first molar.

The anterior superior alveolar branch provides sensory fibers to the maxillary incisor and canine root ends and the periodontal structures

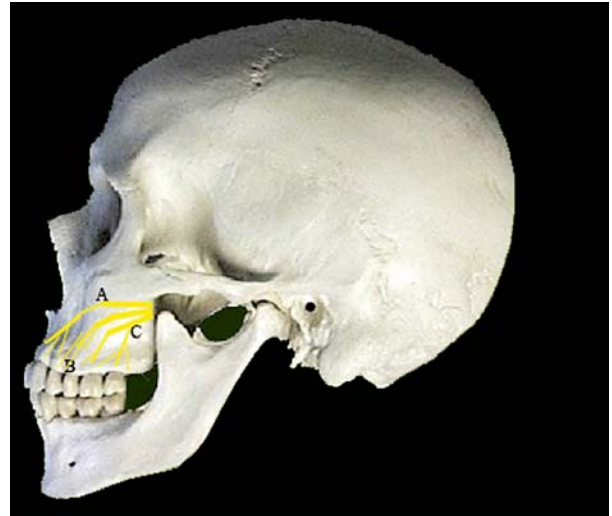


Fig. 21.1: Branches of superior alveolar branches; A: Anterior-superior alveolar nerve; B: Middle superior alveolar nerve; C: Posterior-superior alveolar nerve

Greater (Anterior) Palatine and Nasopalatine Branches (Fig. 21.2): The anterior (greater) palatine nerve innervates the tissues of the soft palate and tonsillar area. The nerve also supplies sensory fibers to the tissues of the hard palate.

The nasopalatine branch of the maxillary nerve innervates the soft and hard tissues of the anterior quadrant from the midline laterally to the maxillary canine tooth. There may be accessory innervation to the incisor teeth also.

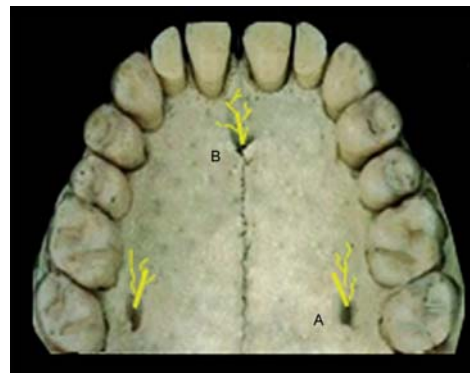


Fig. 21.2: (A): Greater palatine and (B): Nasopalatine branches emerging from greater palatine foramen incisive foramen respectively



Terminal Branches of Mandibular Nerve

Inferior Alveolar (Mandibular) Nerve (Fig. 21.3): The inferior alveolar nerve is the largest branch of the mandibular division of the trigeminal nerve. It arises at the level of the Lateral pterygoid muscle and descends between the sphenomandibular ligament and the medial surface of the ramus of the mandible entering the mandibular canal by way of the mandibular foramen. It courses the canal anteriorly and divides into two terminal branches, the mental and incisive nerves.

Adequate pulpal anesthesia for all the mandibular teeth can be achieved by nerve block procedure. The cortical plate of bone in the mandible is thicker in the molar region and presents a barrier for an effective pulpal anesthesia during suprapariosteal infiltration technique. On the other hand, acceptable pulpal anesthesia can be achieved through suprapariosteal injections for primary and permanent incisors.

During the growth and development the shape and position of the mandible and its relation to the cranium changes. As an example, the location of the mandibular foramen in the child is inferior to its site in an older individual. The mandibular ramus is narrower antero-posteriorly in the child than in an adult. This may necessitate adjustments in the nerve block procedure. The line of delivery of the syringe will be in a slightly downward direction to accommodate the more inferior location of the foramen. The needle's depth of penetration will be less in children.

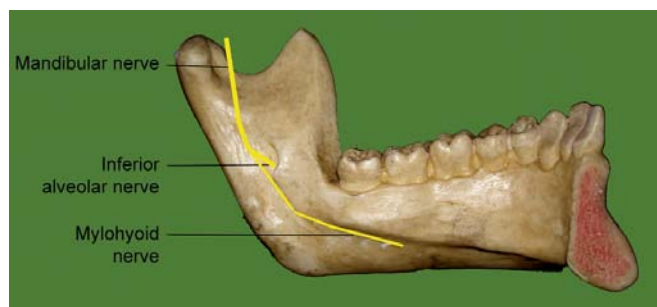


Fig. 21.3: Inferior alveolar and mylohyoid nerves

Mental and Incisive Nerves (Fig. 21.4): The mental nerve exits from the mental foramen and innervates the skin and mucosa of the lower lip and chin as well

as the gingival tissues labial to the mandibular incisors. The incisive nerve furnishes sensory fibers to the first premolar, the canine, and the mandibular incisor teeth. The innervations are through a plexus of nerve branches that also decussate with like branches from the opposite side of the midline.



Fig. 21.4: Mental nerve emerging out of mental foramen: (A Mental nerves)

Long Buccal Nerve: The long buccal nerve is the first branch of the inferior alveolar nerve. Sensory fibers are distributed to the buccinator muscle, the buccal mucosa, and the buccal gingiva over the mandibular molars and second premolar.

Lingual Nerve: The lingual nerve is the second branch from the inferior alveolar nerve. It courses downward, lying lateral to the internal pterygoid muscle, medial to the ascending ramus and within the pterygomandibular space. The nerve courses forward in the lateral lingual sulcus, supplying the anterior two thirds of the tongue and the inferior surface of the sublingual salivary gland. There is sensory innervation to the floor of the mouth and the gingiva of the lingual surface of the body of the mandible.

Mylohyoid Nerve (Fig. 21.3): The mylohyoid nerve has both sensory and motor functions. It is a branch of the inferior alveolar nerve, arising from it and enters the mandibular foramen. Sensory fibers supply the skin about the mental protuberance, the mandibular molars and incisors.



Pain conduction

- A delta fibers : transmit acute pain
: myelinated
: 3-5 μ diameter
: 6-30 meters / second is the rate of conduction
- C fibers : transmits dull, gnawing type of pain
: non myelinated
: 1-3 μ diameter
: 0.5-2 meters / second is the rate of conduction

TOPICAL ANESTHESIA

In dentistry they are used to reduce the discomfort associated with insertion of the needle. They are available in gel, liquid, ointment and spray forms.

Agents Used as Topical Anesthetics

1. Ethyl p-aminobenzoate,
2. Butacaine sulfate
3. Cocaine
4. Dyclonine
5. Lidocaine
6. Tetracaine.

Ethyl p-aminobenzoate (benzocaine) is best suited in dentistry as they provide a rapid onset and longer duration of action. They are not known to produce any allergic reactions.

Method of Application of Topical Anesthetic Agent

The mucosa at the site of application is cleaned and dried. A small amount of the agent is taken on a cotton swab and applied to the tissue (Fig. 21.5). Topical anesthesia is produced in about 30 seconds.

Onset of action for benzocaine is 30 seconds, tetracaine is 60 seconds and lidocaine is 3-5 minutes.

Jet Syringe

It is a needle less method of depositing local anesthetic agent, primarily used for topical anesthesia. The solution is forced through a very small opening, which penetrates the mucosal membrane. This method is not adequate



Fig. 21.5: Topical anesthesia is applied at the site of insertion of needle with a cotton swab

for producing pulpal anesthesia. The post treatment soreness at the injected site and the associated cost are some of the disadvantages of this method.

LOCAL ANESTHESIA

Definition (Malamed,1980)

“The loss of sensation in a circumscribed area of the body due to depression of excitement in nerve endings or an inhibition of conduction process.”

Local Anesthetics

They are drugs that produce anesthesia in the region where it is applied or introduced. It is required that these drugs remain in the local area following their administration and gets absorbed slowly for a prolonged duration of action. Almost all of the local anesthetic agents except cocaine causes vasodilation, which means that these drugs are absorbed at a faster rate into the circulation, decreasing the duration and quality of anesthetic action and may lead to overdose. Thus a vasoconstrictor is added to the local anesthetic solution to counteract the vasodilation.

Vasoconstrictors slows the absorption of the local anesthetic from the site of administration into the



cardiovascular system, reduces the blood flow to the area and thereby reduce bleeding at the site of surgery.

Classification of Vasoconstrictors used with Local Anesthetics

1. Catecholamines
 - Epinephrine
 - Norepinephrine
 - Dopamine
 - Levonordefrin
2. Noncatecholamines
 - Amphetamine
 - Ephedrine
 - Methamphetamine
 - Methoxamine

The above mentioned vasoconstrictors may act directly or indirectly or both to produce the desired action. Examples of directly acting drugs are epinephrine, norepinephrine, dopamine, levonordefrin, methoxamine which act on the adrenergic receptors directly. Amphetamine and methamphetamine acts indirectly by releasing norepinephrine from adrenergic nerve terminals. Ephedrine acts in both ways that is directly on adrenergic receptors and also aid in releasing norepinephrine from adrenergic nerve terminals.

Composition of Local Anesthetic Solution

- I. Local anesthetic agent : Lignocaine hydrochloride 2%
- II. Vasoconstrictor: Adrenaline 1: 50,000 to 1: 2,00,000
Uses- Delays the absorption of L.A from the site
 - a. Provides blood less field
 - b. Prolongs the action
 - c. Reduces systemic toxicity
- III. Reducing agent: Sodium metabisulphite
 - Prevents oxidation of the solution
- IV. Preservative: Methyl paraben, capryl hydro cuprino toxin
- V. Fungicide: Thymol
- VI. Vehicle: Ringer's solution

Dilution of the vasoconstrictor

Concentration of 1:1000 indicates that there is 1 gram (1000 mg) of drug in 1000 ml of solution To produce 1:10,000 concentration, 1ml of 1:1000 solution is added to 9 ml of sterile water to produce 10 ml of 1:10,000 concentration of vasoconstrictor (contains 0.1mg/ml).

To produce 1: 1,00,000 concentration, 1ml of 1:10,000 concentration is added to 9ml of sterile water to produce 10 ml of 1: 1,00,000 concentration of vasoconstrictor (contains 0.01mg/ml).

1:50,000 concentration contains 0.02 mg/ml of vasoconstrictor

1:2,00,000 concentration contains 0.005 mg/ml of vasoconstrictor.

Properties of adrenaline

- Highly soluble in water
- Easily oxidized especially in the presence of heavy metal ions and heat
- Shelf life is only 18 months
- Acts directly on both α and β adrenergic receptors
- Increases the rate and force of cardiac contractions
- Causes dilatation of coronary arteries
- Increases the systolic blood pressure. Decreases the diastolic pressure in small doses and increases in large doses
- Vasoconstriction of peripheral arteries
- Causes bronchodilatation
- In excessive dose stimulates CNS
- Stimulates glycogenolysis in liver and skeletal muscle thereby elevating blood sugar level.
- Inactivated by catechol-O-methyltransferase (COMT) and monoamine oxidase (MAO) enzymes present in the liver.
- About 1% remains unchanged that is excreted in the urine.

Parts of the syringe (Fig. 21.6)

1. Needle with the bevel. It is attached to the barrel through a hub
2. Cylindrical barrel. The solution is contained inside the barrel. It has measurements marked on the outer side which aides in accurate deposition of the required drug.
3. Plunger. It acts like a pump to push the drug out from the barrel through the needle.

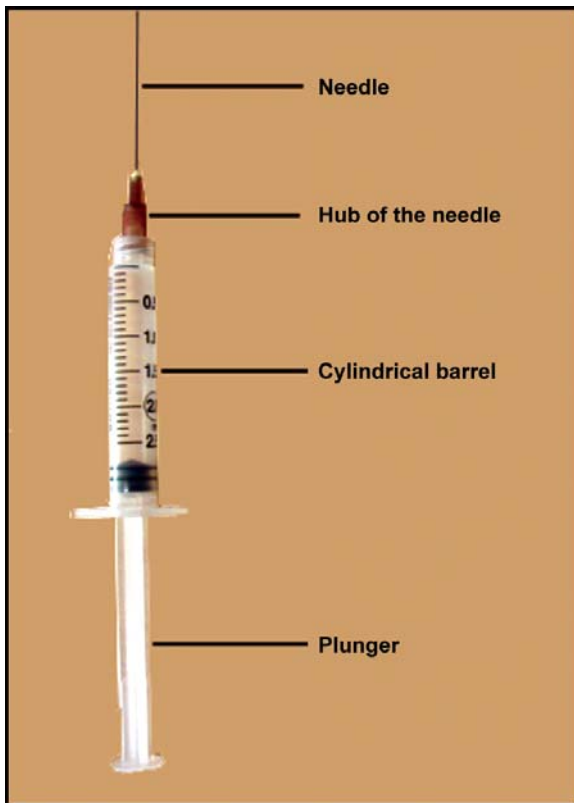


Fig. 21.6: Parts of a syringe

Classification of Local Anesthetic Solution

1. Ester group –
 - a. Benzoic acid esters. Examples are-
 - Cocaine
 - Benzocaine
 - Butacaine
 - Piperocaine
 - Tetracaine
 - b. Para amino benzoic acid esters. Examples are-
 - Procaine
 - Propoxycaine
 - chlorprocaine
2. Amide group
 - a. Bupivacaine
 - b. Lidocaine
 - c. Mepivacaine
 - d. Prilocaine
 - e. Etidocaine
3. Quinoline group
 - a. Centbucridine: It is five to eight times as potent as lidocaine with similar onset of action and

duration. It does not adversely affect the CNS and the CVS in high doses.

Gauge of the needle used- 25, 27 and 30. Out of this 27 is adequate, and 25 has a larger diameter. Length of the needle used- 1inch (short, prevents very deep penetration), 5/8 inch (extra short, for intraligamental), 1.5 inches (long). Rate of solution deposition - 1ml/min or at least 1 ml/30 sec

Maximum amount of local anesthesia that can be given is 4.4 mg/Kg body weight

Anesthetic Agents Suitable for Children, that Rarely Evokes Allergic Reaction

1. Lidocaine hydrochloride, 2% with epinephrine 1:100,000
2. Mepivacaine hydrochloride, 2% with Levonordefrin 1:20,000. It has a more rapid onset and prolonged effect than Lidocaine Hcl.
3. Prilocaine hydrochloride, 4% with epinephrine 1:200,000. It is a shorter acting agent. It should be used in sparing amounts as the metabolic product may promote the chance of developing methemoglobinemia. And therefore should be avoided in persons with anemia, cardiac failure and those who exhibit signs of respiratory failure.

Effects of overdose of anesthetic agent

- Light headedness and dizziness
- Nervous
- Twitching sensation
- Tinnitus
- Sweating
- Vomiting
- Decreased heart rate, blood pressure and respiratory rate
- Tonic clonic seizures

The toxic symptoms of the solution are

- CNS stimulation - due to selective suppression of inhibitory neurons
- Restlessness, tremors, increased talking, increased heart rate.
- Produces clonic convulsions



- Stimulation is followed by depression – fall in the B.P, fall in the heart rate.
- Death is due to the respiratory failure
- In combination with sedative drugs, L.A may have additive CNS depressant effect.

Ideal Requirements of the Anesthetic Agent

- Must provide adequate anesthesia
- Action must be reversible
- Non-irritating to tissues
- Low degree of systemic toxicity
- Rapid onset and sufficient duration of action
- Should not produce allergic reaction
- Readily biotransformed
- Able to be sterilized or be sterile

Potency of the anesthetic agent

- Potency is usually described in terms of the minimal anesthetic concentration that blocks impulse conduction within a specified period of time.
- Local anesthetic potency is related to a number of physicochemical properties, including intrinsic vasodilator activity, tissue diffusion characteristics but lipid solubility is the single most important determinant of local anesthetic potency.
- Highly lipid-soluble anesthetics are very potent, whereas those with low lipid solubility have low potency.
- Etidocaine, has a relatively high potency, due its high lipid-solubility.
- Lidocaine, is one fourth as potent as etidocaine.

Mode of Action of Local Anesthesia

- Local anesthesia is an alkaloid base that form salts when combined with acids. In solution the salt of the local anesthesia compound exists as both uncharged (as free base, which is lipid soluble) and positively charged molecule.
- The potential action of local anesthetic solution depends on the ability of the anesthetic salt to liberate free base. As pH falls, the charged molecule concentration increases more than free base concentration (The reverse happens when pH

increases). That is the reason why local anesthesia is ineffective when given near an area of abscess, where the pH is acidic or low.

- Local anesthetics are suggested to interfere with the conduction of action potentials along peripheral nerve fibers by impairing the functions of sodium ion channels. Nerve impulses cannot be propagated when adequate numbers of sodium channels are not available.
- Recovery from nerve blockade is dependent on redistribution and metabolism of the local anesthetic solution

Absorption, Metabolism and Excretion of Anesthetic Agent

Absorption

1. Increased vascular area and without adrenaline – faster is the absorption
2. Infection and low pH – slows down the absorption

Metabolism

Ester group

- Inactivated by hydrolysis in plasma by plasma cholinesterase.
- Any factor that would contribute to a decrease in plasma cholinesterase activity could allow serum concentrations of an ester-linked local anesthetic to rise and thus increase the likelihood of systemic toxicity.
- The use of amino-ester local anesthetics should be avoided when possible, if decreased cholinesterase activity is suspected.

Amide group

- Inactivated in the liver by microsomal enzymes.
- Prilocaine is most rapidly metabolized and this accounts for its relatively low systemic toxicity.
- Hepatic metabolism of amide-linked local anesthetics can be affected by any factor that alters liver function, such as hepatic disease and drugs.
- The renal clearance of amide agents is inversely related to their protein-binding capacity. Renal clearance also is inversely proportional to the pH of urine, suggesting urinary excretion by nonionic diffusion.

**Excretion**

- The local anesthetic agent is excreted from the kidney.

Duration of Action of the Anesthetic Agent

- The duration of action of local anesthetics is directly proportional to protein-binding characteristics.
- Agents that are highly protein bound (for example, etidocaine and bupivacaine) have the longest duration of action
- Those with lower protein-binding capacities (for example, lidocaine and mepivacaine) have shorter durations of action.

Complications following Local Anesthetic Administration

1. *Due to the solution* – Toxicity, idiosyncrasy, allergy, anaphylactic reaction, infection, local irritation.
2. *Due to the needle* – Trismus, syncope, edema, broken needle, infection, hematoma, sloughing, and bizarre neurological symptoms.
3. *Self inflicted injury* – The numb feeling that is produced may cause postoperative complications such as lip, tongue or cheek biting leading to severe soreness and ulcerations.

Toxicity: Ability of a drug to have deleterious effect on the living being.

Idiosyncrasy: Non-immunological hypersensitivity to a substance

Allergy: Immunological hypersensitivity to a substance

Anaphylactic reaction: Acute type of life threatening allergic reaction seen when a person is exposed to an allergen to which he is already sensitized.

Different types of syringe

1. Metal cartridge type syringe
2. Plastic cartridge type syringe
3. Jet injector syringe
4. Disposable plastic syringe
5. Computer controlled local anesthetic delivery systems

Computer controlled local anesthetic delivery systems (CCLD)

This method of delivery system has an edge over the conventional method in providing controlled deposition of the solution. It enables the dentist in accurate placement of the needle while delivering the predetermined amount of solution through a foot activated control. The pain perceived by the patient is also reduced compared to the traditional method.

The Wand/ CompuDent system, Comfort Control Syringe, Quick Sleeper and Anaject are some of the CCLD systems available in the market.

Contraindications for Local Anesthetic Administration

There is no absolute contraindication, but precautions should be taken in the following conditions:

1. Very insane – mentally retarded
2. Chronic debilitating disease – septicemia, diabetes, bacteremia
3. Bleeding disorder
4. Steroid therapy – Adrenal crisis. So patient should be asked to double the dose
5. Anticoagulant therapy
6. Liver or renal disorder
7. Epilepsy – initial stimulation action of lignocaine may cause seizure
8. Radiation therapy – may further reduce blood supply leading to bone necrosis
9. Hyperthyroidism – adrenaline may cause thyroid storm

Onset and Duration of Action of Anesthesia of 2% Lignocaine 1:100,000 Epinephrine**Onset of Action**

Infiltration – 2 minutes

Block – 2-4 minutes

Duration of Action

Infiltration - Pulpal – 1 hour

- Soft tissue- 2½ hours



- Block
- Pulpal – 1½ hour
 - Soft tissue – 3-5 hour

Factors Responsible for Successful Administration of a Local Anesthetic Agent in a Pediatric Patient

1. Able patient management
2. Concealment of the syringe
3. Appropriate use of a topical anesthetic agent
4. Effective exchange of the syringe between the assistant and the operator
5. Appropriate anesthetic agent
6. Competency of the injection process

Points to be kept in mind Regarding the Differences between a Child and Adult Patient

1. The bone in the maxilla and mandible of the adult is heavier and more compact, whereas in the child it is varyingly less dense and incompletely calcified. So diffusion of the L.A agent through the layers of the bone is faster in children.
2. The anatomic structures of the child are naturally smaller than those of the adult, so the depth of penetration of the needle should be less in children.
3. Penetrating too deeply at the area of the tuberosity can produce a hematoma should the pterygoid venus plexus or posterior superior alveolar artery be injured.
4. The depth of the needle penetration must be reduced because the ramus of the mandible is shorter vertically and narrower anteroposteriorly.
5. With an adult, the emotional aspect of the local anesthetic process is seldom a factor. For the child, however the procedure is very much an emotional issue.

TYPES OF INJECTION PROCEDURES

1. *Nerve block*: The anesthetic agent is deposited near the main nerve trunk
2. *Local infiltration*: Profusion of the drug at the terminal ends of the branches
3. *Field block*: Refers to the placement of the solution around the principal terminal branches.

ANESTHESIA FOR THE MAXILLARY TISSUES

- A. Infiltration
- B. Posterior superior alveolar nerve block
- C. Middle superior alveolar nerve block
- D. Maxillary anterior region block
- E. Infraorbital nerve block
- F. Palatal infiltration
- G. Nasopalatine nerve block
- H. Greater palatine nerve block

ANESTHESIA FOR THE MANDIBULAR TISSUES

- A. Infiltration
- B. Inferior alveolar block
- C. Mental nerve block

Maxillary and Mandibular Infiltration

The needle penetration for infiltration site on the labial aspect is determined by two anatomic landmarks, the mucobuccal fold and mucogingival junction (Sweet's line). The needle penetration site is 2 to 3 mm apical to the mucogingival junction and the depth not more than 2 to 3mm deep. About 0.5 ml of the solution is deposited. In the maxilla, palatally the needle is penetrated at the site corresponding to the root apex which is about at the junction of the horizontal and the vertical portion of the palate (Fig. 21.7).

In the mandible (Fig. 21.8) the solution is deposited in the buccal and lingual vestibule. The amount deposited is about 0.5.

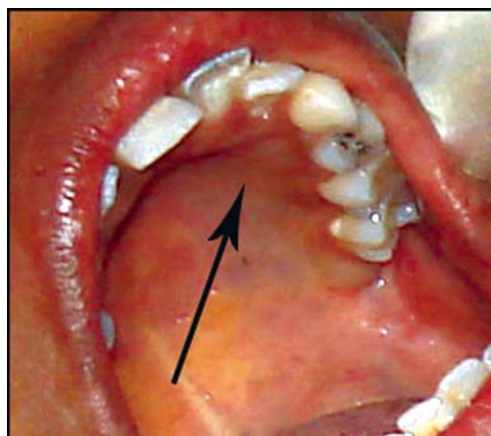


Fig. 21.7: Needle position during palatal infiltration



Fig. 21.8: Needle position during infiltration on the labial aspect

Posterior Superior Alveolar Nerve Block (Fig. 21.9)

Innervates the posterior maxillary deciduous molars. They can be anesthetized as follows:

- Needle is inserted immediately behind the buttress of the zygoma at the height of the vestibule.
- Tip of the needle must be in close proximity to the periosteum.
- Foramen is approximately 8 mm from the insertion point in a 3 year old and 11mm in a 14 year old.

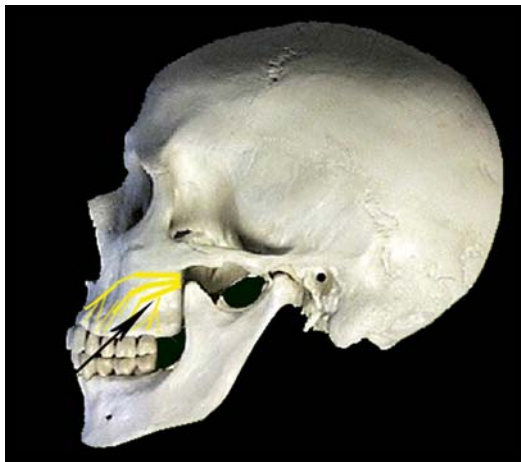


Fig. 21.9: Needle position for posterior superior alveolar nerve block

Middle Superior Alveolar Nerve Block (Fig. 21.10)

Innervates the premolars and the mesiobuccal root of the first permanent molar. The method of anestheti-

zation is similar to posterior superior alveolar nerve.

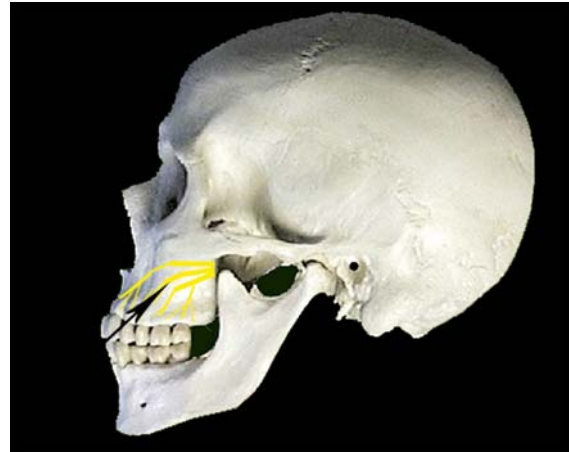


Fig. 21.10: Needle position for middle superior alveolar nerve block

Maxillary Anterior Superior Nerve Block (Fig. 21.11)

Depositing the solution in the apical region of the anterior teeth provides satisfactory anaesthesia of the labial side of the maxillary anterior region in most cases.

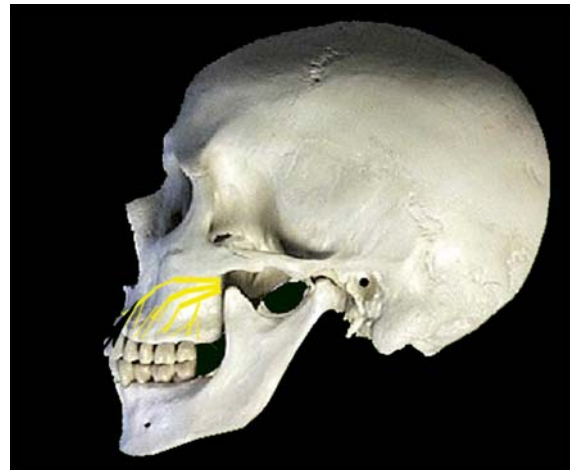


Fig. 21.11: Needle position for anterior superior alveolar nerve block

Infraorbital Nerve Block (Fig. 21.12)

It is given in case of swelling and when infiltration has failed. The infraorbital foramen in a 3 years old is about 5 mm above the vestibular depth.



Fig. 21.12: Needle position during infraorbital nerve block (A: Infraorbital nerves)

Palatal Infiltration

Less pain is encountered when injected into the depth of the rugae as they contain less sensory endings. The amount deposited is about 0.2 to 0.3 ml.

Nasopalatine Nerve Block (Fig. 21.13)

Nasopalatine nerve innervates the maxillary anterior teeth. It is indicated when vestibular infiltration is inadequate. About 0.2-0.3 ml of L.A is administered at the entrance of the incisive foramen on the incisive papilla.

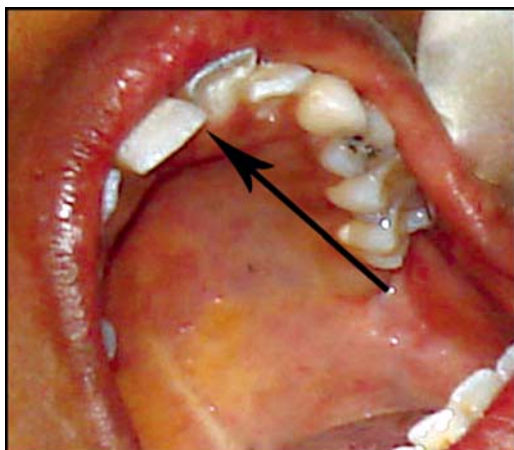


Fig. 21.13: Needle position for nasopalatine nerve block

Greater Palatine Nerve Block (Fig. 21.14)

Greater palatine nerve innervates the maxillary posterior teeth in the palatal aspect. It is anesthetized at the region

midway between the midline of the hard palate and the palatal surface of the posterior teeth.

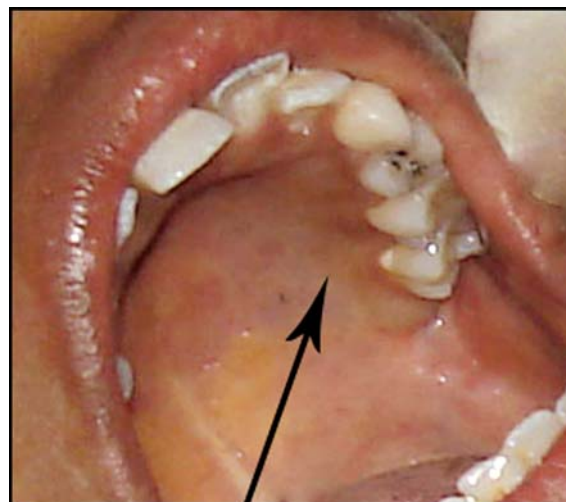


Fig. 21.14: Needle position for greater palatine nerve block

MANDIBULAR ANESTHESIA

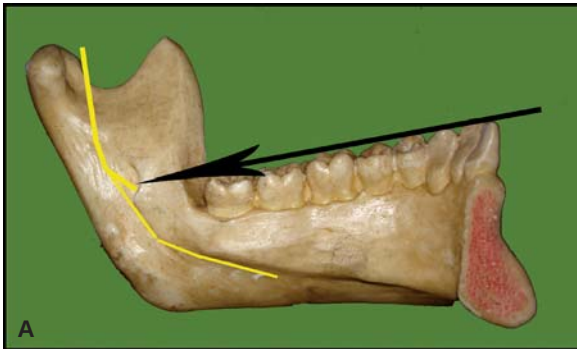
Inferior Alveolar Block (Figs 21.15 A and B)

Most common block used for anesthetizing the molars and premolars. The needle is penetrated into the pterygomandibular space and the solution is deposited close to the mandibular foramen. Factors to be considered are:

- In children the mandibular foramen is located near the posterior border of the ramus. In a 3 year old the foramen is about 5 mm from the posterior border and 20 mm from the anterior border.
- The foramen invariably aligns with the deepest concavity on the anterior border of the mandible.
- Mucosal depression on the medial aspect of the mandible formed by the medial pterygoid muscle also aligns with the inferior alveolar foramen and should be the point of insertion of the needle.

Technique of Inferior Alveolar, Lingual and Long Buccal Nerve Block

- The anterior border of the ramus is palpated, with the finger or thumb resting in its greater curvature.
- It should be observed that as the medial pterygoid ligament passes inferiorly and laterally to attach at the base of the mandible, a triangle is formed by



Figs 21.15A and B: A: Needle position for inferior alveolar nerve block; B: Needle position in the patients mouth

the anterior border of the ramus, the medial pterygoid muscle and the lateral pterygoid muscle. The apex of the triangle is placed inferiorly. An imaginary, longitudinal line dividing the tip of the finger or thumb as it rests in the coronoid notch passes medially over a depressed area just above the apex. The penetration site of needle is the point of intersection.

- The anesthetic syringe is introduced into the oral cavity parallel with the occlusal plane of the mandibular posterior teeth.
- The needle depth is 8-10 mm from the mucosal surface. The amount deposited is 0.9 to 1.0 ml.
- Lingual nerve is anterior and medial to the inferior alveolar nerve. So the needle has to be withdrawn and solution deposited half the distance from the inferior alveolar foramen. The amount deposited is about 0.5 ml.

- The buccal nerve can be anesthetized by infiltration in the buccal sulcus distal to the permanent teeth. The amount deposited is about 0.2 ml.

Boundaries of pterygomandibular space

Anterior: Pterygomandibular raphe and superior constrictor of pharynx

Posterior: Parotid gland

Floor and Medial: Medial pterygoid muscle

Lateral: Ramus of the mandible

Roof: Lateral pterygoid muscle

Needle pathway during inferior alveolar nerve block is

Mucosa, thin plate of buccinator muscle, loose connective tissue and variable amount of fat

Mental Nerve Block (Fig. 21.16)

Is effective in producing anesthesia for the premolars and anterior teeth. The amount deposited is 0.5 to 1.0ml.

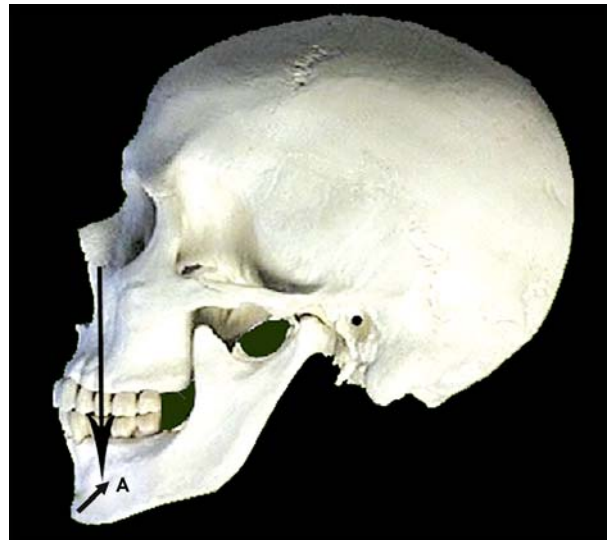


Fig. 21.16: Needle position for mental nerve block (A: Mental nerves)

COMMONLY MADE MISTAKES

1. Waving the needle in front of the patient. It is important from the behaviour management point of view to place the needle and other instruments



behind the patient. The needle should be kept out of the direct vision of the child.

2. Not getting supportive control of the patient's head and hands. It is difficult and dangerous to administer anesthesia or perform any treatment on a child who is hypermotive. So adequate reinforcement to restrict the movements of the head and the extremities is necessary so as to avoid complications.
3. Using long needles. Depth of penetration of a needle is very less compared to that in adults. Use of short needles will ensure that the needle does not extend into deeper tissues.
4. Using inappropriate doses. Young's rule or Clarke's rule can be used while deciding the appropriate dose for a child patient.
5. Fast injection- Care must be taken for slow administration of the solution. Time should be allowed for slow dispersion of the solution into the tissues. Ideal rate of deposition is about 1ml / min, preceded by application of topical anesthesia and aspiration to avoid intravascular injection.
6. Not advising patients or parents regarding the post anesthesia side effects. Children should be strictly told not to bite their lips or cheek until the effects subside. Parents should be told to supervise this at home. Children usually tend to chew on the lips as it does not cause pain and feel like chewing gum and this can lead to severe laceration that can lead to ulceration (Figs 21.17A and B).



Figs 21.17A and B: A: Ulcers on the lips due to biting following inferior alveolar nerve block; B: Wound on the cheek that occurred due to continuous rubbing or scratching of the anesthetized area following inferior alveolar nerve block

EXTRACTION OF TEETH

The principles of extraction of a permanent and a deciduous teeth are the same. But care must be taken keeping in mind the anatomic and physiologic difference between an adult and a child. The surgical instruments designed for adult procedures can be used effectively for the child patient, although forceps are available (Figs 21.18A and B) that are specifically designed for the small mouth. They are small and can be easily concealed and less fear inspiring.

Forceps such as Cowhorn and elevators that, by virtue of their design and function, threaten the underlying developing permanent teeth should be

avoided. Narrow root picks and mosquito-beaked forceps are the instruments of choice for root removals.

Rationale for Deciduous Tooth Removal

A number of conditions predispose the need for removal of deciduous teeth. They are as follows:

Acute Pathologic Involvement

This involvement represents an acute periapical infection of a carious deciduous tooth. The microorganisms may be virulent enough to produce an infection that is



Figs 21.18A and B: A: Forceps for extraction of lower teeth. Note the beak and the handle are perpendicular to each other; B: Forceps for extraction of upper teeth. Note the beak and the handle are in same line

diffused and distended, such as cellulitis. The tooth is extracted if it is destroyed beyond rehabilitation (Fig. 21.19).



Fig. 21.19: Acute infection of first deciduous molar with furcal involvement that cannot be rehabilitated

Chronic Pathologic Involvement (Fig. 21.20)

A primary molar usually presents with furcal radiographic changes, and the deciduous anterior tooth may have changes seen in the apical portion. This presents with a parulis or a draining abscess. The risk for the normal development of the permanent tooth bud due to the infective environment warrant the extraction of the diseased deciduous tooth.

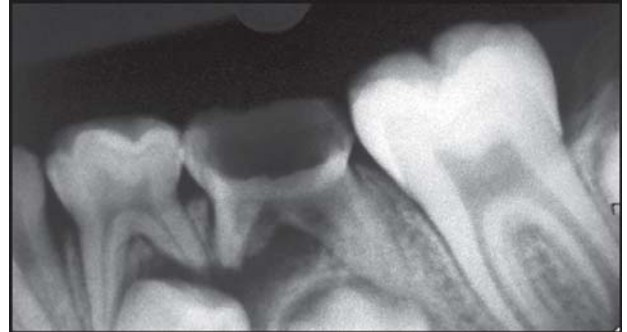


Fig. 21.20: Chronic infection of deciduous teeth as seen with relation to second deciduous molar may hinder the development of the permanent tooth

The Over Retained Deciduous Tooth

The deciduous tooth may be retained for several reasons such as:

- If the erupting succedaneous tooth is malposed, the resorptive process on the deciduous tooth may be irregular.
- The resorptive process may also be affected by endocrine disturbances or vitamin deficiencies.
- Atypical resorption of a deciduous tooth root may cause it to be overretained.

Such an over retained deciduous tooth should be extracted to allow normal eruption and alignment of the permanent successor.

The Ankylosed Deciduous Tooth

Such tooth shall be extracted when the cessation of vertical alveolar bone growth is observed, as evidenced by deciduous tooth submergence, followed by the placement of a space maintainer.

The Cariously Involved, Nonrestorable Deciduous Tooth (Fig. 21.21)

When caries has seriously involved the clinical crown of a tooth and is non restorable, the tooth should be removed.



Fig. 21.21: Second deciduous molar beyond rehabilitation and is indicated for extraction

The Natal or Neonatal Tooth

The natal tooth, which has erupted before birth, or the neonatal tooth, usually erupting within one month following birth, must be considered for extraction if

- The tooth is mobile and there is a chance of aspiration
- The tooth is a source of mechanical irritation, causing ulceration on the ventral surface of the tongue
- There is interference with breastfeeding.
- The natal or neonatal tooth may be a supernumerary tooth.

The Supernumerary Tooth (Fig. 21.22)

The supernumerary tooth, erupted or impacted, is capable of diverting eruption of a permanent tooth from its normal path, impacting it, or delaying its eruption and should be removed.



Fig. 21.22: Supernumerary teeth (mesiodens) seen erupting palatally is advised for extraction

The Fractured or Traumatized Tooth

Trauma can result in various kinds of trauma to the anterior teeth. Such a deciduous tooth that imposes risk to the permanent teeth should be removed.

The Impacted Tooth

The impacted tooth may be a supernumerary tooth, a malformed tooth, or an unerupted, ectopically placed tooth.

Contraindications to Tooth Removal

The removal of a tooth is contraindicated where acute symptoms of oral or systemic disease are manifested in the child patient such as:

Acute Systemic Infections

After the acute stages of systemic infections, such as glomerulonephritis, congenital heart disease, rheumatic fever, rheumatic heart disease, are reduced to chronicity, regimens of chemoprophylaxis will be required before extractions.

Blood Diseases

The hemophilic or leukemic child will require a well-trained general dentist, a pediatric dentist, or an oral surgeon along with a hematologist to perform satisfactorily the measures required during tooth removal.

Uncontrolled Diabetes Mellitus

Tooth removals should be avoided. Surgical wounds heal poorly, and postoperative pain can be extreme. Recurrent hemorrhages may result.

Irradiated Bone

Tooth removal should be avoided. If an extraction is necessary, it should be accomplished before radiation therapy. Osteomyelitis usually develops following an extraction in an irradiated patient because of osseous avascularity.

Acute Oral Infection

In the presence of oral infections, such as acute necrotizing ulcerative gingivitis, acute herpetic stomatitis,



acute dentoalveolar abscess, and other acute forms of oral disease, tooth removals are definitely contraindicated until the infections are eliminated.

Special consideration while deciding whether a primary tooth has to be extracted or retained:

- *Child management* – If the emergency is severe enough, the tooth has questionable prognosis and treatment may require many appointments in a child who is difficult to manage then the tooth is extracted followed by placement of a space maintainer.
- *Degree of root resorption*– If $> \frac{1}{2}$ of the root is resorbed and the tooth requires pulp treatment then it is extracted
- *Space problems* – If there is an existing space problem, early extraction of the tooth may allow space closure. In such cases tooth has to be retained by pulp treatment
- *Degree of parental concern* – If parents exhibit an obvious lack of concern over the emergency situation related to the injured tooth, the tooth is removed
- *Habits* – Deleterious oral habits if present will enhance the rate of space closure. In such cases tooth must be retained
- *Speech* – Early loss of the anterior teeth may have a direct effect on the speech patterns and this is another reason for maintaining the tooth in the arch.
- *Aesthetics* – For psychological purpose it is better to postpone the extraction

Position of the Operator and the Patient (Figs 21.23A to D)

Patient position: The dental chair is positioned such that the back is about 45° to the floor during extraction of the upper teeth and at about 90° while extracting the lower teeth. The height of the chair is adjusted such that the operator does not need to bend nor lift his/her arm above the shoulder. Practically the operator must be able to perform the procedure without straining oneself. The position of the operator is in front of the patient for extraction of teeth in all the quadrants except the lower right posterior quadrant. During the extraction of the teeth in the lower right posterior quadrant the operator sits or stands at about 11 O' clock position.



Figs 21.23A to D: Operators and patients position during extraction: A: Upper teeth extraction; B: Lower anterior extraction; C: Lower right posterior quadrant extraction; D: Lower left posterior quadrant extraction

EXTRACTION OF THE LOWER TEETH

Precautions to be taken

The dentist should explain to the child the sensations and experiences to be encountered before administration of the local anesthetic. The child should also be informed briefly the procedure of extraction in a simple language so that the child can be prepared and be ready for the procedure. To the uninformed child the sensation of pressure from the forceps during the extraction procedure can be interpreted as pain, and extraneous noise and osseous sound conduction associated with luxation may aggravate the anxiety. Explanation and



demonstration to the child that pressures and noises associated with tooth extraction need not be feared is very important as the primary step.

When a mandibular tooth is removed, it is prudent to stabilize the mandible by providing support under the mandible (Fig. 21.24).

During extraction of deciduous teeth extra care must be taken to avoid the unintentional accidental removal of the permanent tooth bud.

Another measure of precaution is the use of a throat guard that acts as safety screen over the oropharynx behind the tongue to guard against swallowing or aspiration of an extracted tooth.

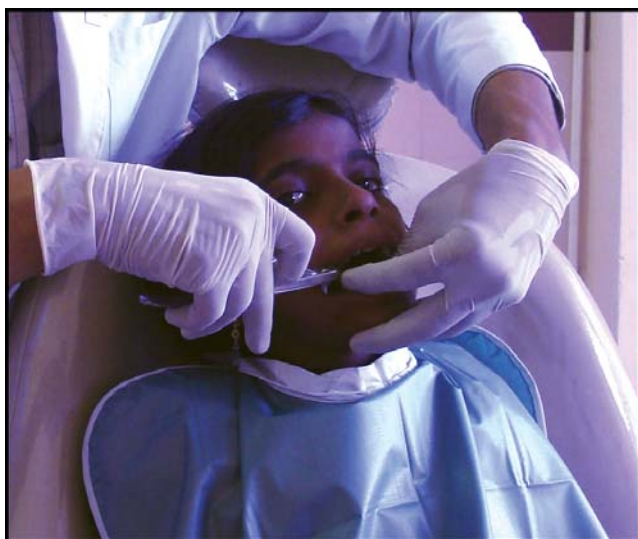


Fig. 21.24: Supporting mandible during extraction of lower teeth are very important to prevent dislocation

Primary Incisors and Canines

Procedure

1. Periosteal elevator is used to free the attached gingiva from the cervix of the tooth labially and lingually. The tooth can be luxated slightly with the same instrument, especially if the tooth is mobile.
2. Firm apical pressure is maintained with the forceps. Gently direct the initial luxative force lingually/palatally and carefully apply the next toward the labial side. A rotative force is applied along the tooth's long axis, delivering it through its path of least resistance.

3. Mold the labial and lingual or palatal plates of the alveolar bone into normal conformity with digital pressure.
4. Fold and place a sterile gauze sponge over the wound to help establish hemostasis. Immediately before patient dismissal, place a fresh sterile gauze over the wound with instructions to remove it after 10-20 minutes.

Primary Molars

Procedure

1. Periosteal elevator is used to free the attached gingiva from the cervix of the tooth labially and lingually. The tooth can be luxated slightly with the same instrument, especially if the tooth is mobile.
2. Firm apical pressure is applied with the forceps (Fig 21.25). Initial luxation movement is toward the buccal side. Hold pressure momentarily, permitting buccal alveolar plate expansion. Return the luxating force lingually/palatally. Hold pressure to permit lingual alveolar plate expansion. Alternate the buccal and lingual/palatally movements to further expand the cortical plate. When there is adequate freedom of movement, deliver the tooth to the buccal side, exercising slow, firm, continuous pressure.
3. Mold the labial and palatal cortical plates into normal conformity with finger pressure. Place a folded sterile gauze over the wound during the hemostatic process.



Fig. 21.25: Firm apical pressure is applied with the forceps. The crown is held at the cervical portion. Note the position of the non-operating hand used for supporting the alveolus



ANALGESICS AND ANTIBIOTICS USED IN DENTISTRY

Anti-inflammatory Analgesics

Inflammation is the body's effort to inactivate or destroy microorganisms, remove irritants and aid in repair. Inflammation is triggered by the chemicals released by the injured tissue such as histamine, bradykinins, prostaglandins, interleukin etc. The typical clinical signs that are seen during inflammation such as pain, swelling, redness and increase in temperature are due to the release of these chemical mediators.

Analgesics are drugs that are prescribed to relieve patient from pain. Analgesics are basically of two types, the opioid (Narcotic drugs) and the Nonsteroidal anti-inflammatory drugs (NSAID). The opioids are less preferred to the NSAIDs as the later do not cause any kind of drowsiness. NSAID's are effective anti-inflammatory, analgesic and antipyretic drugs and are routinely used in dental practice. They act primarily by inhibiting the cyclooxygenase enzymes that catalyze the first step in prostaglandin synthesis.

Classification of Non-Steroidal Anti-inflammatory Drugs

1. Non-selective COX inhibitors-
 - Salicylates. Example- Aspirin
 - Propionic acid derivative. Example- Ibuprofen
 - Anthranilic acid derivative. Example – Mephenamic acid
 - Aryl-acetic acid derivative. Example – Diclofenac
 - Oxicam derivative. Example – Piroxicam
 - Pyrrolo-pyrrole derivative. Example – Ketorolac
 - Indole derivative. Example – Indomethacin
 - Pyrazolone derivative. Example – Phenyl-butazone
2. Preferential COX-2 inhibitors. Examples - Nimusulide
3. Selective COX-2 inhibitors. Examples – Rofecoxib, Valdecoxib
4. Analgesic- Antipyretics with poor anti-inflammatory action
 - Para-aminophenol derivatives. Example – Paracetamol
 - Pyrazolone derivative. Example – Metamizol
 - Benzoxazocine derivative. Example – Nefopam.

Commonly used NSAIDs in Pediatric Dentistry

NSAIDs	Properties	Indications	Side effects
Aspirin	• Absorbed well from stomach and small intestine • Plasma half life is 15-20 minutes • Slow penetration through blood brain barrier but rapid through placental barrier • Excreted through urine	• Good analgesic for dental pains than visceral pains • Good anti-inflammatory, anti-pyretic	• Gastric irritation, nausea, vomiting • Interferes with platelet aggregation, prolonging the bleeding time hence should not be given along with warfarin, naproxen, methotrexate or phenytoin • Should be stopped one week before any surgery • In the presence of viral infections may cause Reye's syndrome • No relative side effects.
Paracetamol	• Good analgesic and anti-pyretic, weak or negligible anti-inflammatory action	• Mild to moderate pain with little inflammation. Patients with gastric irritation to other NSAIDs. Can be safely prescribed to children	
Ibuprofen	• Plasma half life is 2 hours • They cross blood brain and placental barrier • Metabolized in liver and excreted in urine	• Moderate to severe pain with moderate inflammation. Can be safely prescribed to children	• Gastric irritation, nausea and vomiting • Headache, dizziness, tinnitus has been noticed. Since they inhibit platelet function should be avoided with anticoagulants.
Mefenemic acid	• Has peripheral and central analgesic action • Oral absorption is slow • Metabolized in liver • Excreted in urine and bile	• Pain of muscle or joint origin associated with mild inflammation	• Diarrhea, epigastric distress.
Ketorolac	• Absorbed rapidly orally • 60% remains unchanged and is excreted through urine • Plasma half life is 5-7 hours	• Severe pain and moderate inflammatory condition	• Nausea, dyspepsia, loose stools, headache, dizziness.



Combination of Paracetamol and Ibuprofen

This combination has an addictive effect. Scientifically no extra benefit has been observed while using this combination. Though this combination is readily marketed and used, its use should be restricted to a short period.

- Small muscle mass in children –large doses not possible
- Complications like pain, swelling and abscess formation
- Severe complications like anaphylactic shock and syncopal attacks

Antimicrobial Agents used in Dentistry

Antibiotics are drugs used to combat infections. The term antimicrobial agents are more apt as these drugs act against microbes responsible for a particular disease.

Very few antimicrobials are prescribed routinely by the dentists. But the knowledge of other oral AMAs is essential because a patient may already be taking some other oral AMAs for non-dental problems which could be good enough for dental problem as well.

Advantage of Oral Antimicrobial Agents

1. Oral antimicrobial agents bring the infection under control faster and also prevent the progression of the disease to a more severe form.
2. Effective against most of the pathogenic micro-organisms.
3. Have the ability to prevent complications of infections.
4. Reduce the need for hospitalization.
5. Most convenient and cost effective.
6. No need for frequent visits.
7. Side effects are minimum.
8. Anaphylactic reactions are rarely seen.
9. Convenient frequency of administration which can be either four, three, twice or even just once a day.
10. Easy to consume and is available in different flavors.
11. Hospitalization is avoided

Antimicrobial Agents Commonly used are

- Semi-synthetic penicillins. Example—Amoxycillin.
- Cephalosporins
- Macrolides. Example—Erythromycin, Roxithromycin, Azithromycin and Clarithromycin
- Nitroimidazoles. Example—Metronidazole

Advantages of amoxycillin over ampicillin

- Amoxycillin is **better absorbed than** ampicillin
- **Serum level of** amoxycillin achieved is **twice more than by** ampicillin
- **Less diarrheal episodes with** amoxycillin **than** ampicillin.

Commonly Encountered Infections in Dental Practice

1. Periapical infection
2. Cellulitis and its complication like Ludwig's angina
3. Periodontal infections
4. Gingival infections
5. Osteomyelitis

Disadvantage of injectable antimicrobial agents

- Need for frequent administration
- Fear of injection in children and even adults

Amoxycillin: They are bactericidal and act by interfering with bacterial cell wall synthesis. It is well absorbed and food does not interfere with absorption. Incidence of diarrhea is less and is eliminated via urine.

Effective against gram +ve organisms such as staphylococcus, β hemolytic streptococcus, *Streptococcus viridans*, and few gram –ve organisms such as *E. coli* and *H. influenzae*.

Dosage: 20 to 40 mg/Kg body weight/day in 3 divided doses.

Cephalosporins: They are β -lactam antibiotics closely related structurally and functionally to penicillins and are effective against a wide array of bacteria, ranging from Streptococci to gram –ve bacilli including pseudomonas.



- They are administered IV or IM due to poor oral absorption.
- Adequate distribution in the body.
- Elimination occurs through tubular secretion and or glomerular filtration.
- Adverse effects are allergic manifestations and bleeding.

Cephalosporins have been divided into 4 generations based on the spectrum of activity

- First generation cephalosporins
 - Highly effective against gram +ve organisms that the gram -ve organisms.
 - Effective against streptococcus and few staphylococcus organisms.
 - Gastrointestinal side effects are rare
 - Better taste
 - Used in soft tissue infections
 - Cephalexin and Cefadroxil are the commonly used oral Cephalosporins
- Second generation cephalosporins
 - Effective against *Staphylococcus aureus*, *Beta hemolyticus streptococci*, *H. Influenzae*, *E. coli*, *Klebsiella* and *Proteus*
 - Examples are Cefaclor and Cefuroxime axetil
- Third generation cephalosporins
 - More useful against Gm -ve infections.
 - Convenient frequency of administration
 - Expensive
 - Examples are Cefixime, Cefpodoxime and Cefdinir
- Fourth generation cephalosporins
 - They have wider antibacterial spectrum and is active against methicillin susceptible *streptococci* and *staphylococci*, gram negative organisms
 - Example is Cefepime

Macrolides

- Erythromycin, Roxithromycin, Azithromycin and Clarithromycin
 - These are effective against organisms susceptible to Penicillins.
 - They act by inhibiting protein synthesis of the microorganism
 - They are available as enteric coated tablets as they are otherwise destroyed by gastric acid.

- Metabolites are excreted in the urine.
- Side effects include epigastric distress, cholestatic jaundice, ototoxicity.
- Roxithromycin and Azithromycin are newer macrolides.

Clarithromycin is more active against staphylococcus and streptococci than erythromycin but less effective against *H. influenzae*. Azithromycin is less effective against staphylococcus and streptococcus as compared to Erythromycin.

Metronidazole:

- Belongs to Nitroimidazole group
- Highly effective in anaerobic infections
- Dosage 30 mg/kg/day in 2 to 3 divided doses.
- Metallic taste, nausea, disulfuram like action in adults
- Mechanisms of action – interferes with DNA function leading to inhibition of bacterial protein synthesis.

Selection of Antimicrobial Agents

An appropriate antimicrobial agent is selected based on the following factors:

1. *Infecting organism.* This is done based on scientific methods, by isolating organism from pus, blood or tissues. This is based on experience or knowledge of clinical presentation and probable pathogens that are unique for a particular site.
2. *Site of infection:* Adequate levels of agent must reach the site of infection. Some natural factors may act as barriers. Common barriers are blood brain barrier or the placental barrier. Other factors that determine the effectiveness of the agent at the site of infection are solubility of the drug, molecular weight of the drug and protein binding ability of the drug.
3. *Health or medical history of an individual:* For example, agents that are concentrated or eliminated by liver such as erythromycin are contraindicated in treating patients with liver disease. Patient's immune system also plays a major role in eliminating the microorganisms along with antimicrobial agents. The therapeutic effect of the antimicrobial agents may be altered in immunocompromised patients as associated with infection with HIV.
4. *Route of administration of the drug:* Oral route is selected for mild to moderate infections as it can be



used on an outpatient basis and is economical. But certain drugs such as vancomycin are poorly absorbed from the gastrointestinal tract and have to be administered parenterally.

5. *Safety of the agent:* Antimicrobial agents that are specific for a particular microorganism and possess least amount of toxicity should be preferred.

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Chapter 22



Gingival and Periodontal Diseases in Children

1. Introduction
2. Differences between the Child and Adult Periodontium
3. Reasons Why Gingivitis Rarely Progress to Periodontitis in Prepubertal Children
4. Physiologic Gingival Changes Associated with Tooth Eruption
5. Etiology of Gingival Diseases
6. Classification of Gingival Diseases
 - Gingivitis
 - Eruption gingivitis
 - Gingivitis associated with poor oral hygiene
 - Gingivitis associated with HSV I infection
 - Gingivitis associated with aphthous stomatitis
 - ANUG
- Gingivitis associated with acute bacterial infection
- Chronic non-specific gingivitis
- Puberty gingivitis
- Hereditary fibromatosis gingival enlargement
- Drug induced hyperplasia
- Scorbutic gingivitis
7. Classification of Periodontal Diseases
 - Pre-pubertal periodontitis
 - Localized aggressive periodontitis
 - Generalized aggressive periodontitis
 - Papillon lefevre syndrome



INTRODUCTION

The periodontium is a connective tissue organ covered by epithelium that attaches the teeth to the bones of the jaws and provides a continually adapting apparatus for support of teeth during function.

It comprises of (Fig. 22.1)

- Gingiva
- Periodontal ligament
- Alveolar bone
- Cementum

DIFFERENCES BETWEEN THE CHILD AND ADULT PERIODONTIUM

Features seen in a Child

1. Greater sulcus depth—1.4-2.1mm
 2. Free gingiva—thicker and rounder due to cervical bulge and underlying constriction
 3. Flaccid and retractable marginal gingiva due to immature connective tissue and gingival fiber system and also due to increased vascularization
 4. Attached gingiva—greater width
 5. Presence of interdental cleft, found in interradicular zone and retrocuspid papilla, 1 mm below the free gingival groove lingual to mandibular canine
 6. Periodontal space is wider with few fibres
 7. Alveolar bone
 - Less calcified
 - More vascular
 - Few but thicker trabeculae
 - Larger marrow space
 - Thin lamina dura
 - Flattened interdental crests
 8. Gingivitis is common than periodontitis and is more transient and acute, compared to progressive and chronic in adults.
3. Altered composition of plaque
 4. Decreased leukocytic migratory rate due to low levels of immunoglobulin specific for plaque bacteria and decreased vascular inflammatory response.

REASONS WHY GINGIVITIS RARELY PROGRESS TO PERIODONTITIS IN PREPUBERTAL CHILDREN

1. More anabolic activity due to increase metabolism
2. Absence of bacteria responsible for periodontal disease such as *Spirochetes* and *B. melaninogenicus*

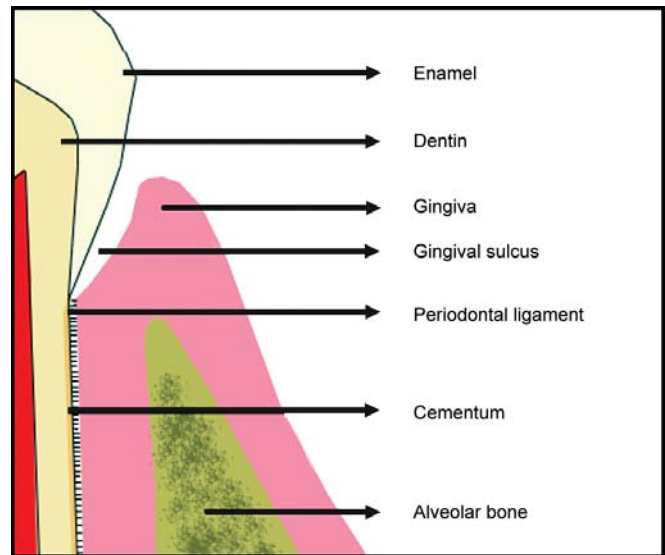


Fig. 22.1: Components of Periodontium

Common gingival diseases

1. Acute pericoronitis
2. Eruptive gingivitis
3. ANUG
4. Gingival fibromatosis and hyperplasia

Common periodontal diseases

1. Prepubertal periodontitis - localized and generalized
2. Early onset periodontitis- juvenile periodontitis
3. Associated with systemic diseases

PHYSIOLOGIC GINGIVAL CHANGES ASSOCIATED WITH TOOTH ERUPTION

Gingival changes that occur during the eruption of tooth can be studied, by dividing the eruption into 3 stages, as follows

- Pre-eruptive stage
- Eruptive stage
- Posteruptive stage



Pre-eruptive Stage

Before the crown appears in the oral cavity, the gingiva presents a bulge that is firm (Figs 22.2 and 22.3), may be slightly blanched and conforms to the contour of underlying crown.



Fig. 22.2: Bulge appears on the ridge just before the tooth erupts into the oral cavity



Fig. 22.3: Teeth seen just erupting through the ridge few days after the previous picture was taken

Eruptive Stage

This stage is associated with formation of gingival margin. Marginal gingiva and sulcus develop as the crown penetrates the oral mucosa. In the course of eruption the gingival margin is usually edematous, rounded and slightly reddened (Fig. 22.4).

During the period of mixed dentition it is normal for marginal gingiva around the permanent teeth to be quite prominent, particularly in the maxillary anterior region. At this stage in tooth eruption the gingiva is still attached to the crown and it appears prominent when superimposed on the bulk of the underlying enamel.



Fig. 22.4: Rounded and red gingival margin around the erupting tooth

Posteruptive Stage

The gingiva reduces in bulk and becomes more thin and tight and firmly attached around the cervical portion of the tooth.



Fig. 22.5: Thin gingival margin seen around a fully erupted tooth

CLASSIFICATION OF PERIODONTAL DISEASES

- Pre-pubertal periodontitis
- Localized early onset periodontitis
- Generalized early onset periodontitis

Gingivitis

It is the inflammatory involvement of gingival tissue. Microscopically it is characterized by presence of inflammatory exudate and edema and destruction of



collagenous gingival fibers. Ulcerations of the epithelium are also seen.

Stages of Gingivitis

Stage I: Initial lesion

- A. Time period—2 to 4 days
- B. Vascular dilatation and vasculitis is seen
- C. Junctional and sulcular epithelium are seen infiltrated by polymorphonuclear cells.
- D. Associated with mild change in color.

Stage II: Early lesion

- A. Time period—4 to 7 days
- B. Increased vascular proliferation.
- C. Junctional and sulcular epithelium is seen infiltrated by polymorphonuclear cells, rete pegs formation, atrophic areas.
- D. Lymphocytes are predominant
- E. Loss of collagen
- F. Clinical findings include erythema, bleeding on probing.

Stage III: Established lesion

- A. Time period—14 to 21 days.
- B. Increased vascular proliferation and blood stasis.
- C. Changes seen in the junctional and sulcular epithelium are more severe than stage II.
- D. Plasma cells are predominant.
- E. Severe loss of collagen
- F. Clinical findings include changes in color, size and texture etc.

Stage IV: Advanced lesion

- A. The lesion extends into alveolar bone
- B. Characterized by periodontal breakdown.

Clinical Features of Gingivitis

- 1. *Gingival bleeding*: Two earliest symptoms of gingival inflammation are:
 - Increased gingival fluid production rate.
 - Bleeding from gingival sulcus on probing
- 2. Change in the color of gingiva:
 - Normal color is coral pink. Inflamed tissue is red or bluish red.

- 3. Changes in consistency of gingiva:
 - In chronic inflammation, both destructive (edematous) and reparative (fibrotic) changes co-exist.
- 4. Changes in surface texture of the gingiva:
 - Loss of surface stippling is an early sign of gingivitis.
 - Chronic inflammation—the surface is either smooth and shiny or firm and nodular depending on whether changes are exudative or fibrotic.

ETIOLOGY OF GINGIVAL DISEASES

- I. Local irritating factors
 - A. Bacterial plaque
 - B. Predisposing factors like: material alba, food debris, malalignment of teeth, dental calculus etc.
- II. Local functioning factors
 - A. Malocclusion
 - B. Habits: mouth breathing, tongue thrusting
 - C. Eruption of teeth
- III. Systemic factors
 - A. Puberty
 - B. Vitamin or protein deficiency
 - C. Drugs and chemicals
 - D. Pregnancy
 - E. Hereditary
 - F. Metabolic disorders
 - G. Hematological disorder
 - H. Viral, bacterial and fungal infections

CLASSIFICATION OF GINGIVAL DISEASES

- 1. Simple Gingivitis:
 - A. Eruption Gingivitis
 - B. Gingivitis Associated With Poor Oral Hygiene
- 2. Acute Gingival Inflammation
 - Herpes simplex virus infection
 - Recurrent apthous ulcer
 - Acute necrotizing ulcerative gingivitis
 - Acute candidiasis
 - Acute bacterial infections
- 3. Chronic non specific gingivitis:



4. Conditioned gingival enlargement:
 1. Puberty gingivitis
 2. Fibromatosis
 3. Phenytoin-induced gingival overgrowth
5. Scorbutic gingivitis

Eruption Gingivitis

- o Seen during the eruption of teeth and subsides soon after
- o Greatest incidence is 6 to 7 years when permanent teeth begin to erupt
- o Reason for this is due to lack of protection to the gingiva from the coronal contour of the tooth
- o It may be painful and develop into pericoronitis or pericoronal abscess
- o Management includes improving oral hygiene. Some severe cases may require antibiotic therapy.

Gingivitis Associated with Poor Oral Hygiene

- o Oral hygiene and gingivitis are directly related
- o Adequate oral hygiene practice leading to thorough plaque removal and eating raw fiber vegetables and fruits have beneficial effect on reducing gingivitis
- o It can be grouped as early, moderate and advanced gingivitis (Fig 22.6)
- o Early gingivitis is quickly reversible and treated with good tooth brushing and flossing
- o Moderate and severe gingivitis requires more elaborate measures.



Fig. 22.6: Advanced gingivitis seen due to heavy calculus deposits

Gingivitis Associated with HSV I Infection

- Caused by the herpes simplex virus (HSV),
- Herpetic stomatitis is a common oral disease which develops in both children and young adults.
- It rarely occurs before the age of six months, apparently because of the presence of circulating antibodies in the infant, derived from the mother.
- The disease occurring in children is frequently the primary attack
- It is characterized by the development of fever, irritability, headache, pain upon swallowing and regional lymphadenopathy.
- Within a few days the mouth becomes painful and the gingiva intensely inflamed.
- The lips, tongue, buccal mucosa, palate, pharynx and tonsils may also be involved.
- Shortly, yellowish, fluid-filled vesicles develop. These rupture and form shallow, ragged, extremely painful ulcers covered by a gray membrane and surrounded by an erythematous halo
- They heal spontaneously within 7 to 14 days and leave no scar.
- Treatment is symptomatic such as application of topical anesthetic agents on the ulcers, soft diet and adequate fluids

Gingivitis Associated with Aphthous Stomatitis

- It can be triggered due to any stress, gastrointestinal disturbance, nutritional deficiency, hormonal imbalance, infection, allergy etc.
- Of the three types of aphthous minor apthae are common
- Prodromal phase of paresthesia at the site of ulceration is observed. The ulcers appear in crops of two or three and are less than 10 mm in diameter
- Ulcers are painful and are discrete or confluent.
- Persists for about 12 days and heals with no scar formation
- Treatment is symptomatic. Chlorhexidine or Nystatin or tetracycline can be prescribed if they are infected.



Acute Necrotizing Ulcerative Gingivitis (ANUG)

1. Caused by *Borrelia vincentii* and spirochetes
2. Severe ulcerating gingivitis involving the interproximal papillae, covered by a pseudomembrane is seen
3. Associated with fetid odor
4. Recovery promptly occurs within 36 hours after penicillin therapy and application of hydrogen peroxide

Gingivitis Associated with Acute Bacterial Infection

- Caused by streptococci group of bacteria
- The gingiva is painful that bleeds easily
- Papilla is enlarged with associated gingival abscess
- Treatment includes broad spectrum antibiotics, improvement of oral hygiene and chlorhexidine mouth wash

Chronic Nonspecific Gingivitis

- No specific etiology. May be triggered by hormonal imbalance seen in the preteenage and teenage children
- It may be localized to the anterior region or may be more generalized
- It is rarely painful, but persists for a longer period of time
- Since the cause is nonspecific the treatment is limited to maintaining the oral hygiene and regular professional prophylaxis

Puberty Gingivitis

- Occurs in the prepubertal and pubertal period
- Gingival inflammation is confined to the anterior segment and may be limited to single arch only
- Gingiva on the lingual aspect is relatively uninvolved
- Concerned with maintenance of adequate oral hygiene, removal of local irritants, and restoration of caries.

Hereditary Fibromatosis Gingival Enlargement (Fig. 22.7)

- Characterized by slow progressive, benign enlargement of the gingiva



Fig. 22.7: Hereditary fibromatosis gingival enlargement

- The surface is normal appearing
- Appears as soon as the deciduous teeth erupt into the oral cavity and cover the teeth completely
- They are fibrous tending to displace the teeth and are non painful
- They regress only if the teeth are extracted
- Surgical excision is the treatment of choice but they recur to the original condition within a period of few years

Drug-induced Hyperplasia (Fig. 22.8)

- Phenytoin, an anticonvulsant drug is the commonly seen cause of hyperplasia of the gingiva. Other drugs that induce hyperplasia are cyclosporine and Nifedipine.
- Appears as early as 2 to 3 weeks after initiation of the phenytoin therapy and peaks at 18 to 24 months.
- They cause painless enlargement of the gingiva at the interproximal aspect.
- Buccal and anterior segment are more often affected than the lingual and posterior segment.



Fig. 22.8: Drug-induced hyperplasia



- Gingiva appears pink and firm unless infected.
- Normally do not bleed readily
- Formation of pseudopockets
- Associated problems are during mastication, speech, etc.
- Management includes adequate oral hygiene maintenance, change of drug or dosage and surgical excision.

Scorbutic Gingivitis

- Associated with vitamin C deficiency
- Involvement is limited to marginal tissue and papillae
- Associated with severe pain, spontaneous hemorrhage
- Management includes replacement of ascorbic acid and oral hygiene maintenance

Pre-pubertal Periodontitis

- Normally it is generalized, but when it occurs in deciduous dentition it is localized
- Loss of attachment and alveolar bone loss is seen in deciduous dentition in the molar and incisor region
- Plaque accumulation is minimum. Gingival inflammation may be present
- Seen soon after the eruption of the primary teeth
- Premature loss of teeth is common and all teeth may be lost by 3 years of age
- *Actinobacillus actinomycetomcomitans*, *bacteroids*, *fusobacterium* are found in the gingival pocket
- Management includes early diagnosis, dental curettage, prophylaxis, removal of severely mobile teeth, and broad spectrum antibiotics.

Localized Aggressive Periodontitis (Localized Juvenile Periodontitis)

- Seen in otherwise healthy children
- Characterized by rapid and severe loss of alveolar bone around more than one permanent tooth involving the first molars and incisors
- Appears self limiting
- No tissue inflammation is seen and little plaque or calculus is present
- Bone loss is 3 to 4 times faster than adult periodontitis

- Caused by *actinobacillus actinomycetomcomitans* and *bacteroids* like organisms
- Management includes early diagnosis, dental curettage, prophylaxis, removal of severely mobile teeth, and broad spectrum antibiotics.

Generalized Aggressive Periodontitis (Generalized Juvenile Periodontitis)

1. Seen at around puberty
2. Affects the entire dentition (Fig. 22.9)
3. Caused by non motile, facultative, anaerobic, gram negative rod *P. gingivalis*
4. Management includes early diagnosis, dental curettage, prophylaxis, removal of severely mobile teeth, and broad spectrum antibiotics.

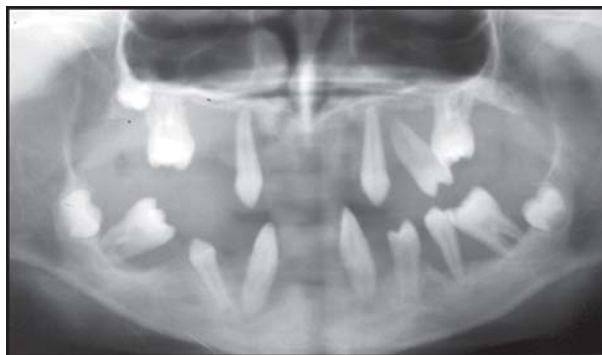


Fig. 22.9: Radiograph showing loss of many permanent teeth in Generalized Aggressive Periodontitis

Papillon Lefevre Syndrome

1. Cause is unknown, familial tendency is present
2. Primary teeth erupt at normal time
3. Increased tendency to bleed
4. Palms and soles exhibit hyperkeratosis
5. Teeth become loose with associated severe horizontal bone resorption
6. Permanent dentition may be normal
7. Management includes tetracycline therapy and extraction followed by complete denture.

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Chapter 23



Prosthodontic Considerations in Children

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2. Indications for Prosthetic Replacement
3. Aims of Prosthodontic Rehabilitation
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 - Pin ledge and partial veneer crown retainers
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DEFINITION

Prosthodontics is an “art and science which deals with replacement of missing tooth and related structures in and around oral cavity with artificial substitutes”.

Prosthesis is an artificial substitute.

INDICATIONS FOR PROSTHETIC REPLACEMENT /PROSTHESIS

1. Premature loss of teeth
2. Dentinogenesis imperfecta, amelogenesis imperfecta
3. Cleft lip and palate
4. Ectodermal dysplasia
5. Anodontia
6. Grossly decayed tooth.

AIMS OF PROSTHODONTIC REHABILITATION

Restoration of Esthetics

Children feel rejected or get ridiculed when they loose their anterior tooth or teeth and this may have a profound effect on the personality of a child. Such a child often exhibits a marked improvement in performance when provided with a denture.

Restoration of Masticatory Efficiency

Children become choosy about the type of food when they loose their posterior teeth as it becomes difficult to bite or chew. Masticatory efficiency is improved when dentures are provided.

Prevention and Correction of Speech Abnormality

Speech articulation is found to be poorer in children with many missing teeth especially the anterior teeth than with children with a full set of teeth. After a period of wearing complete dentures, however, the edentulous children show a significant improvement in articulation.

Prevention of Harmful Habits

When teeth are lost, the child may place the tongue into the edentulous spaces, resulting in abnormal tongue thrusting

habit. Habits of sucking the lips inward can sometimes be observed in children with missing anterior teeth.

Provision of Space Maintenance

Single or multiple tooth loss in the primary dentition requires space maintenance. This may in the form of a partial denture, which in addition to preserving space for succeeding teeth, helps with mastication, speech and esthetics.

Obturation of Congenital and Acquired Defects of Orofacial Structures

Dentures or other removable prosthetic appliances may be required to provide closure of defects in the maxillofacial complex that may be developmental or acquired in origin (such as cleft palate, surgical treatment for neoplasm or trauma).

The benefits of providing such appliances depend on the site and extent of the defect and may include the facilitation of feeding and speech development and improvement in appearance.

HARMFUL EFFECTS OF PROSTHESIS AND ITS PREVENTION

Prosthesis may cause tissue damage and children may not understand or realize the early symptoms. Denture-induced tissue damage may progress very rapidly in young patients and it is therefore of great importance to institute and maintain all necessary preventive measures properly.

Caries

Increased caries risk is associated with any kind of prosthesis as it is associated with altered pattern of plaque accumulation and difficulty in maintenance of oral hygiene. The design of the prosthesis should be such that there is minimal tooth surface contact as practically possible. Good comprehensive caries prevention program should be initiated with regular monitoring.

Periodontal Disease

Gingival inflammation associated with poor oral hygiene and proximity of appliance is very common. Improved



and rigorous oral hygiene measures are required to prevent damage to the periodontium that are associated with denture wear.

Effects of Growth and Development

Prosthesis in children should be changed regularly as it becomes difficult to seat the appliance in the mouth over a period of time. This is due to increase in the arch dimensions that is observed due to the normal growth and development. Care should be taken while designing prosthesis in children. It should not interfere in jaw growth and tooth eruption.

Loss of Alveolar Bone

Preservation of alveolar bone is an important consideration in young patients who requires longer periods of denture wear. Whenever possible a partial denture should be supported on fully erupted abutment teeth. Excessive movement of the prosthesis on the alveolar bone should be avoided as these will cause resorption of the alveolar bone. When insufficient teeth are present to provide support, the denture base should be extended widely on the bone to distribute the loads.

Oral Mucosal Disorders

A number of mucosal disorders may be associated with denture wear. Localized pressure from an over-extended or ill fitting denture may produce a painful area of necrosis (denture ulcer) or mucosal hyperplasia. Denture-induced stomatitis affecting the palatal mucosa is characterized by a bright red spongy appearance of mucosa in an area well demarcated by the denture margins.

These denture-induced mucosal disorders can be prevented by institution of adequate oral and denture hygiene measures in the first instance and by ensuring that features of the fitting surface that might produce mechanical irritation are relieved before denture insertion.

EXAMINATION, DIAGNOSIS AND TREATMENT PLANNING

Clinical examination of the child is carried out in the usual manner, however, radiographic examination needs

particular attention. Ideally a panoramic radiograph would be desirable so that one could visualize the different stages of development at which the various succedaneous teeth, are at that particular point in time. This information helps the operator to predict the approximate time and perhaps the sequence of eruption of the succedaneous teeth and also decide whether a particular patient presents the indications for a prosthesis. The stage of treatment planning at which a prosthesis is inserted will vary in accordance with the different needs of various patients.

Mouth Preparation

It includes the procedures performed inside the mouth to create an oral environment that will provide proper support and retention for the prosthesis and that will prevent the development of forces or processes that are harmful to the remaining teeth and their supportive tissues.

- A. *Surgical preparation:* Surgery may be necessary to eradicate soft tissue or osseous pathology and can range from uncomplicated extraction of teeth to complex procedures.
- B. *Periodontal preparation:* Adolescents often require periodontal surgeries particularly to increase crown length and to improve tissue contours so that more ideal results in restorative and prosthetic treatment are achieved.
- C. *Endodontic preparation:* Endodontic therapy may be required to preserve a tooth that is strategic to the support and retention of a proposed partial denture but grossly damaged by caries or trauma.
- D. *Orthodontic preparation:* Orthodontic procedures can be used to reposition a malpositioned teeth that may serve as a abutment.
- E. *Prosthetic preparation:* Placement of a crown may be required on a grossly decayed tooth acting as an abutment which will provide support and retention to the denture.

TYPES OF PROSTHESIS

- A. Removable Prosthesis
 - a. Partial dentures
 - b. Complete dentures/over dentures



- B. Fixed Prosthesis
 - a. Resin bonded retainers
 - b. Pin ledge and partial veneer crown retainers
 - c. Inlay retainers
 - d. Complete crown retainers
 - e. Cantilevered prostheses
 - f. Restoration for a single tooth.
- C. Obturator: Discussed in Chapter 19.

Removable Partial Denture (Figs 23.1 A and B)

Indications

1. As space maintainers when there is premature loss of primary teeth. Helps to restore speech, esthetics and masticatory function.
2. When anterior deciduous teeth are missing and esthetics is a major consideration.
3. Young permanent teeth lost as a result of trauma.
4. Congenitally missing tooth/teeth, e.g. partial anodontia in ectodermal dysplasia.
5. When fixed prosthesis cannot be used, e.g. excessive span length, inability to achieve adequate retention.
6. Causes resulting in multiple extractions of primary teeth, e.g. nursing bottle caries.
7. Dentinogenesis imperfecta, amelogenesis imperfecta and cleft palate associated with multiple missing teeth either congenitally or following extraction.

Ideal Requirements

1. It should restore or improve masticatory function.
2. It should restore and improve esthetics and facial contours.
3. It should not interfere with normal growth of the dental arches.
4. Design should not interfere with speech.
5. Should allow easy placement and removal by the patient.
6. The design should permit easy adjustment and alterations if required.
7. Easily cleansable.
8. Its design should require minimal or no preparation of the abutment teeth.
9. It should prevent over eruption of opposing teeth or drift of the adjacent teeth.

10. It should prevent plaque accumulation and be non-irritating to the supporting tissues.

Design for Removable Partial Denture in Children

Two very important considerations in children are:

- A. The duration for which the removable partial denture will be worn.
- B. Changing nature of dental arches.

It is very important to ascertain that the force distribution on the teeth and ridge be uniform, which otherwise can cause soft tissue damage, tilting or rotation of abutment teeth. This can be ensured when maximum denture bearing area is used so that the force per unit area is minimal.



A



B

Figs 23.1A and B: Removable partial denture;
A: Pretreatment B: Posttreatment

Parts of a Removable Partial Denture

Usually RPD for children consists of the following parts:

- A. The denture base



- B. Clasp
- C. Artificial teeth.

The denture base: The denture base for most partial dentures are made of acrylic resin, although in some cases it may consist of metal alone or metal and acrylic resin. It provides a means for fixation of the clasps and artificial teeth. The denture base should be light and have sufficient strength to meet the functional needs.

Clasps: They are used to provide adequate fixation or retention of the denture base. They provide tooth support to the denture base. Clasps may be either cast or wrought. Commonly used clasps are 'U' clasp, ball end clasp, Adams clasp etc. Adams clasp is very versatile and is used primarily on posterior teeth. An added aid to retention is the use of labial bow.

Artificial teeth: Commercially primary teeth are available. Teeth can be fabricated from a model by taking an impression of the teeth and duplicating them with a tooth colored resin. The teeth are cut and used as individual tooth.

Procedure for Constructing Removable Partial Denture

Making an impression: Impression trays of different sizes are available. Correct size is selected. The impression material of choice is alginate. The procedure is explained to the child by using simple terms to describe the procedure. It is common for children to gag during impression making. Gagging can be prevented by asking the patients to rinse with warm water containing some flavored surface anesthetic agent prior to impression procedure, by asking the patient to breathe rapidly through nose, or any other methods to distract the child's attention.

Bite registration: A centric bite registration is necessary in order to establish an accurate relationship between maxillary and mandibular models prior to mounting them on the articulator. Bite should be registered in centric relation as some children have a tendency to approximate their incisors in an edge to edge relationship when asked to close. Children should be shown the correct method of biting before recording the bite.

Fabrication of the appliance: The working model is cast in stone and the appliance is fabricated.

Delivery or insertion of the appliance: The patient is shown the proper way to insert and remove the appliance. The patient is asked to demonstrate in front of the dental surgeon to ensure that the patient can accomplish this procedure at home.

Important considerations while designing a partial denture

- A. Full palatal coverage is preferred for maxillary partial denture.
- B. Buccal and lingual flanges should be relatively short and contoured.
- C. Clasps when used should not interfere in tooth eruption and jaw growth.
- D. Occlusal rests should be preferably placed on the permanent molars.
- E. When necessary the appliance should be fabricated before extraction of teeth and used as immediate partial denture or immediate space maintainer.
- F. The teeth are set with spaces and in a more vertical axis than in adult dentures.
- G. The teeth may be butted to the alveolar ridge and labial flange omitted.
- H. As the child grows it may be necessary to remove portions of the appliance to allow for eruption of permanent successors.
- I. Teeth with shallow cusps or a zero degree teeth should be used.

Instructions to the Patient and the Parents

- A. The patient is instructed to remove the partial denture during athletic activities such as swimming and contact sports and store in a small plastic box with water.
- B. The partial denture should be removed at night and stored in water. It should be cleaned every day with denture cleansers or by brushing with denture cleansing paste.
- C. If the denture does not fit or cause irritation the parent should be asked to call the dentist and inform him.
- D. Patient is informed regarding the complications such as prolongation of treatment and extra-expenditure that will occur if the appliance is lost or broken.



- E. Written copy of instruction can be provided regarding the instructions for the care of the appliance.

Advantages of Removable Denture

- Patient or the parent can always remove the denture when there is any pain or other problem.
- Good home care of both the denture and the remaining teeth is easier to accomplish.
- Material costs are minimal.
- Minimal care is required.

Disadvantages of Removable Denture

1. There is complete dependence on patient and parent cooperation. Lack of cooperation can lead to failure of the treatment.
2. Failure to maintain good oral hygiene carries increased risk of caries and gingival disease.

Complete Denture

Indications

Children with loss or missing full set of teeth as associated with certain diseases such as ectodermal dysplasia.

Important considerations while fabricating a complete denture:

1. The alveolar bone deposition is retarded but the face continues to grow. So the appliance has to be changed periodically to adjust for the facial growth and development.
2. Making a centric relation record is difficult in children and hence requires extra-effort and precaution.
3. Over-dentures may be fabricated using the existing teeth for retention of the denture.
4. Teeth with shallow cusps or a zero degree teeth should be used.

Patient Instructions

- a. The child should be encouraged to wear the dentures.
- b. When the dentures are first inserted, the child should be given food that is enjoyed but which requires chewing.

- c. The parents should check the child's mouth for supporting tissue irritation and erupting teeth.
- d. The child should be evaluated every 3 months for changes occurring due to growth.
- e. The appliance should be removed at night and kept moist.
- f. The appliance should be removed for sports activities.
- g. The parents and patients should be instructed in home care of the appliance.

Overdentures

Occasionally congenital abnormalities or trauma result in the loss of multiple teeth and the resulting inter arch relationship does not allow conventional removable partial denture to re-establish proper occlusion with the opposing teeth. This situation may necessitate fabrication of a prosthesis that overlays all or part of the remaining teeth so that proper function and facial esthetics are established.

Fixed Partial Dentures

Types of Fixed Prosthesis

- Resin bonded retainers
- Partial veneer crown retainers
- Inlay retainers
- Complete crown retainers
- Cantilevered prostheses
- Restoration for a single tooth

Important considerations while fabricating a fixed prosthesis:

- a. When a tooth is lost, space maintenance should be provided immediately and should be continued until the fixed prosthesis is cemented.
- b. It should be kept in mind during tooth preparation the presence of large pulp chamber in a young permanent tooth.
- c. If the abutment teeth are malaligned and pulp size does not permit the amount of tooth reduction necessary to align the preparations, orthodontic repositioning of the abutment teeth will be required.
- d. For reasons of pulpal and periodontal health and to conserve tooth structure partial coverage retainers should be the first choice whenever possible.
- e. Conservative retainers are preferred over full coverage retainers.



Resin Bonded Retainers (Maryland Bridge)

Design: They are perforated metal-resin bonded appliance (Fig. 23.2).

Indications:

1. Congenitally missing teeth such as lateral incisors and premolars.
2. Tooth lost to trauma.
3. Anterior teeth missing because of congenital defects such as cleft palate.
4. Carious teeth that have been extracted.

Contraindications

1. Poor oral hygiene.
2. Large carious lesions in abutment teeth.
3. Malpositioned teeth that do not allow for improved esthetics by bonding.

Advantages

1. The cost is less than porcelain fused to metal restorations.
2. Conservative in enamel reduction, reducing trauma to pulp and periodontal tissue.
3. Can be done without local anesthesia.
4. Excellent esthetics.
5. Easy repair.

Disadvantages

1. Contraindicated where large restorations or carious lesions exist.
2. Technique sensitive.

Procedures

i. Anterior Teeth Replacement:

- Lingual reduction is done using a flame shaped diamond bur. The margins are extended slightly beyond the proximal contact to provide a wrap around effect. Shallow grooves can be used. A chamfer is placed 1 mm from the gingival crest.
- An impression of the final preparation is made and model is prepared with die stone. The framework covers as much of the lingual surface as possible yet minimizing the incisal show of the material.
- Framework is tried and checked for occlusion and esthetics.

- The oral side of the casting is polished. The enamel side of the metal is etched and washed.
- Bonding must be done in a dry environment. Bonding agent is applied to etched enamel and metal surfaces. Composite resin is placed on the metal surface only.
- Seat the bridge and carefully remove all excess composite resin. Use the finishing burs for finishing,

A patient with congenitally missing lateral incisor is an ideal candidate for these types of restorative procedure.

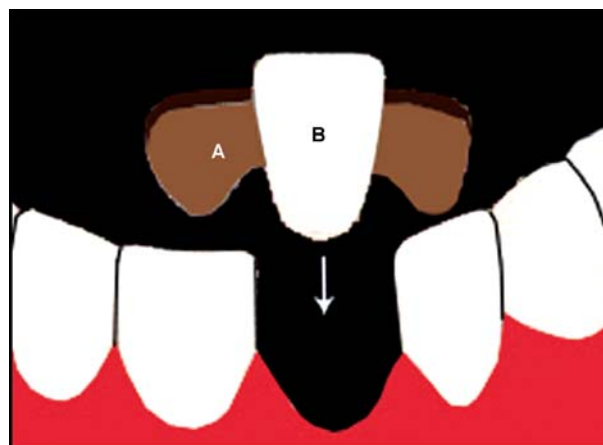


Fig. 23.2: Design of a Maryland bridge; A: Perforated metal extension, B: Pontic

ii. Posterior Teeth Replacement:

- The wraparound designs should cover each tooth by 180 degrees. The height of the contour should be lowered to within 1mm of the gingival crest. The preparation should be as thick as possible yet remain in the enamel to avoid overcontouring.
- Shallow occlusal rests can be used extending into the enamel only. The walls of these occlusal rests must be nearly parallel.
- The steps of try-in, casting, etching and resin polymerization are similar to the steps for anterior restoration.

The acid etch retained cast prosthesis has filled a void in the management of adolescents with missing teeth, whether the cause of tooth loss is trauma or congenital defect. In the past, these tooth lost due to trauma were replaced by removable appliances that were easily



broken or by extensive and expensive fixed prosthodontic appliances. The acid-etch resin retained cast appliance is an excellent substitute that requires minimal tooth reduction and provides excellent esthetic results.

Partial Veneer Crown Retainers

They can be either:

1. Laminate veneers
2. Acid-etch composite veneers.

Laminate Veneers

They are of 3 types:

- A. Preformed laminate veneers
- B. Customized laboratory processed laminate veneers
- C. Porcelain laminate veneers.

Indication

- A. Patients with tetracycline stains, fluorosis, hypoplastic or hypocalcific teeth or other unesthetic anterior teeth.

Contraindication

- A. Teeth with severe labial proclination
- B. Mouth breathers
- C. Exposed dentin
- D. Poor oral hygiene.

A. Preformed Laminate Veneers

These are ready made veneers adapted directly on the prepared enamel surface.

Advantages

- A. Surface color and finish are excellent
- B. Economical
- C. One-step procedure.

Disadvantages

- A. Appears slightly bulky
- B. Increased chair time
- C. Poor gingival adaptation may result in gingival inflammation
- D. Replacement may be difficult

B. Customized Laboratory Processed Veneers

Advantages

- A. Initially surface is very smooth

- B. Easy to finish
- C. Good shade adaptation
- D. Easily repairable
- E. Economical

Disadvantages

- A. It is a two appointment procedure
- B. Surface may roughen over time
- C. May fracture under-stress.

C. Porcelain Laminate Veneers: It requires removal of sufficient tooth material. The veneer is constructed in the laboratory and attached to the tooth by mechanical and chemical methods.

Steps Involved For Veneer Placement:

- A. Isolation of the tooth.
- B. Cleaning with nonfluoride containing paste.
- C. Drying the tooth thoroughly and conditioning with 50% phosphoric acid.
- D. The tooth is then cleaned with water and dried.
- E. A thin layer of bonding agent is painted on the etched surface and polymerized for 20 seconds.
- F. Place the selected shade composite on the inner side of the veneer and place it gently on the abutment tooth.

Acid-etch Composite Veneers

Advantages

- One appointment procedure
- The microfilled composite resins are well adapted to such procedure
- Esthetically excellent
- Economical and easily repairable.

Disadvantages

1. Surface may appear rough after some months
2. Stains may appear
3. Method may require precise technique.

Procedure

1. Isolation
2. Preparing the veneer window of about 1mm in enamel. A collar of enamel is left intact around the labial aspect.
3. The prepared surfaced is etched with 50% phosphoric acid, washed and dried.



4. A thin layer of bonding agent is applied and dried with gentle blow of air.
5. Microfilled light cured composite is adapted on the tooth surface using plastic instrument.
6. The surface is then finished and polished.
7. Glazing is done for the final finish.

Inlay Retainers

Second premolars and first molars sometimes may be replaced by use of inlay retainers in the abutment teeth.

Advantages: The main advantage of the inlay in the young mouth is that its subgingival extension is limited to the proximal surface, whereas adequate retention for an extra-coronal retainer frequently requires total subgingival margin extension because of the short crown frequently present in adolescents.

Tooth preparation

- A. The tooth preparations are of the conventional inlay design.
- B. The occlusal and proximal steps should be wider than those normally prepared for a single inlay restoration.
- C. A post hole about 1.5 mm deep may be used in pulpal floor near the marginal ridge opposite to the proximal box. These modifications are made to increase retention to provide adequate bulk of metal for strength and to provide space for solder joints of proper form, location and size.

Complete Crown Retainers

When full coverage retainers are indicated but pulp size allows only minimal reduction, an all resin fixed prosthesis is the best choice. It offers good esthetics and requires only minimal axial tooth reduction (0.5 mm). Because of its inferior physical properties, it must be replaced periodically. All resin prosthesis rarely lasts more than one or two years without significant wear, color change or fracture. However, by the time replacement is needed, enough pulpal recession may have occurred that additional tooth reduction can be safely accomplished permitting use of metal ceramic retainers.

Cantilevered Prosthesis

Design: This prosthesis replaces missing tooth by taking support from only one abutment tooth.

Indications: This design can be used in selected cases of missing anterior teeth only and is not acceptable when one is replacing posterior teeth. Congenital absence of a maxillary lateral incisor is one situation where this design can be utilized with a reasonable degree of success. A two-unit fixed prosthesis can be fabricated with a lateral incisor pontic cantilevered from the canine retainer.

Requirements: The positional stability of the canine is imperative to the success of this design.

Criteria for case selection

1. The canine should not be mobile and the arch form should be stable.
2. The canine should not have recently undergone orthodontic repositioning that involved significant rotation.
3. There should be no centric occlusal slide and the lateral incisor pontic should be fabricated so as to be out of occlusal contact in protrusive and lateral mandibular movements.

Improved designs

- a. The positional stability of the canine can be improved by placement of a rest arm from the pontic onto the lingual surface of the central incisor.
- b. Concave form can be given to the mesial aspect of the pontic so that it wraps slightly around the distolingual aspect of the central incisor.

Both of these designs require a low caries index and meticulous oral hygiene.

Advantages

1. Less expensive than a conventional three-unit prosthesis and comparable in cost to a three-unit resin bonded prosthesis.
2. Only preparation of the canine is necessary, and since this tooth is larger than an incisor and does not possess pulp horns, it can be adequately reduced with less chance of irreversible pulpal damage.



3. Avoiding the central incisors entirely renders a more esthetic result than either a conventional or a resin bonded prosthesis that includes the central incisor.

Restorations for a Single Tooth

They are

- A. Resin jacket crown
- B. All ceramic crown
- C. Metal ceramic crown
- D. All ceramic and metal ceramic crowns supported by posts and cores.

Resin Jacket Crown (Figs 23.3 and 23.4):

Design: It is a full coverage crown made of acrylic resin and requires minimum tooth reduction.

Indications: A tooth, which requires a full coverage restoration but possess a large pulp that could be irreversibly injured during tooth reduction for an all ceramic or metal ceramic crown.

Tooth preparation

1. The minimal axial reduction depth required for an acceptable resin jacket crown is about 0.5 mm.
2. The tooth preparation for a resin jacket crown should possess a shoulder finish line, 0.5 mm in width around the entire tooth.
3. The lingual reduction for occlusal clearance is also 0.5 mm.
4. An incisal edge reduction of 1 to 1.5 mm is required and is biologically acceptable even in the presence of large pulps.

Advantages

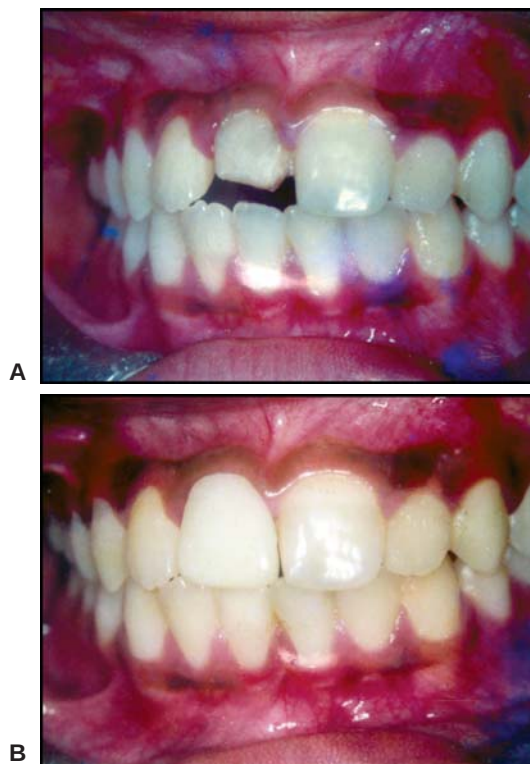
1. Minimal reduction of the tooth material is required.
2. Resin jacket crowns can provide good service for a few years and thereby allow pulpal recession to occur. Then additional tooth reduction can be accomplished in a biologically safe manner allowing utilization of the longer lasting ceramic restoration.

Disadvantages:

1. Poor long-term color stability.
2. Decreased resistance to wear.
3. Greater loss of surface lustre and surface form particularly in mouths where vigorous toothbrushing occurs.



Figs 21.3A and B: Restoration of carious teeth with jacket crowns; A: Pretreatment; B: Post-treatment



Figs 23.4A and B: Tooth restored with jacket crown; A: Preparation of tooth; B: Restoration with jacket crown



All Ceramic Crown

Indications: Used for restoration of single malformed, discolored or fractured tooth.

Requirements

1. Normal tooth preparation form is required to support the restoration.
2. There should be average or below average occlusal forces.
3. The centric occlusal contacts should occur over the concave lingual portion of the prepared tooth
4. The prepared tooth should possess average or greater inciso-cervical length and not be short, round or overtapered in form.

Tooth preparation: Preparation form for a porcelain jacket crown is the same as that used with the resin jacket crown except that greater reduction depths are required. Minimal axial reduction depth required is 0.8mm.

Advantages

1. All ceramic crowns are the most esthetic full coverage restorations presently available in dentistry.

Disadvantages

1. Requires more tooth reduction so risk for pulpal damage is high.
2. All ceramic crowns cannot withstand greater occlusal forces and therefore cannot be used for restoration of posterior teeth.
3. Proper tooth form is required to support the restoration.

Metal Ceramic Crown

Design: The crown is backed by metal and a ceramic facing for esthetics is provided.

Indications: When inadequate preparation form or the magnitude of occlusal forces contra-indicates an all ceramic crown, the stronger metal ceramic crown is indicated.

Tooth preparation

1. Minimal facial reduction of 1 mm and shoulder finish line is given on the facial surface.

2. Minimal incisal reduction of 2 mm.
3. Lingual axial reduction depths of 0.3 to 0.5 mm with a chamfer finish line.
4. Lingual reduction of 1 mm for occlusal clearance.

All Ceramic and Metal Ceramic Crowns Supported by Posts and Cores

A routine root canal treatment is done. The root canal is obturated with gutta percha occupying only apical 1/3 of the root canal. The remaining portion of the canal is further enlarged to accommodate a post and core restoration which is cemented in the canal.

Indications

1. Fracture involving the pulp in the teeth with closed apex.
2. Pulpless permanent incisors or premolars to be restored with ceramic restorations should receive posts and cores when only a thin peripheral shell of tooth structure remains after tooth preparation.

Contraindications

- a. It is contraindicated in tooth with short root, or with roots having a thin dentinal wall as in an immature tooth.
- b. Tooth with internal and external root resorption.
- c. Traumatic occlusion.

Post and Core Design

1. When post and core build up is required, the post should extend into the root canal so that its length equals or exceeds the occluso-cervical length of the proposed ceramic crown. This length provides adequate retention and optimal resistance to tooth structure.
2. Any coronal tooth structure remaining after normal preparatory procedures should be preserved and the core constructed to complete the normal coronal preparation form. Retaining coronal tooth structure helps to increase the resistance of post and core to rotational dislodging forces (Figs 23.5 and 23.6).
Whenever possible cervical margins of crowns should not be extended into the gingival sulcus of an adolescent patient. It can lead to accelerated gingival recession in case oral hygiene is inadequate or interfere with normal



cervical relocation of the gingival tissues as the patient matures. Either occurrence produces an esthetic liability.



Fig. 23.5: Preformed post placed in the distal canal of a molar



Fig. 23.6: Cast post cemented in the anterior teeth

Patient instructions:

1. Every adolescent patient must be taught proper oral hygiene and home care of prosthetic restorations and be motivated until adequate performance is routinely achieved.
2. Each patient with a fixed prosthesis should be taught the use of oral hygiene aids such as the floss and the interproximal brush to enhance oral hygiene efforts.

Implant Prosthesis

The routine successful use of osseointegrated dental implants in total or partial support of prosthesis in adults has heightened interest in their use with younger patients. There are two primary concerns related to the placement of implants before growth is completed.

- A. The effects of growth on long term positional stability of dental implant.
- B. The effect of implant supported prosthesis on future dental and skeletal growth.

Implant Usage Before Growth Completion

The clinician must understand the dynamics of positional relationship between the dental implant and its biologic environment in a growing patient.

The behavior of an osseointegrated dental implant essentially resembles an ankylosed tooth. Two facets of the relationship of the ankylosed teeth to their actively growing environment must be understood.

First, the ankylosed tooth lacking the adaptive mechanism of healthy tooth does not erupt normally and becomes buried.

Second, failing to participate in normal growth it often creates severe malocclusion secondary to tipping and associated growth changes in normal teeth adjacent to the affected ankylosed tooth.

It seems logical that an osseointegrated implant placed prematurely could elicit the same negative growth effects. An understanding of growth and development and its variability within the male and female adolescent population gives us serious concern for the premature placement of implants.

It is best to wait until maxillary and mandibular growth is completed before placing implants. Implants have been placed in anterior mandibular region in patients as young as five years of age. But the placement of dental implants should not be attempted until the accelerated phase of circumpubertal growth is close to complete.

Implants for Orthodontic Anchorage

Osseointegrated implants have been used as anchorage in cases where anchorage is required but conventional tooth anchorage is not available. Because the implants act as ankylosed teeth and are incapable of being moved by orthodontic or orthopedic forces they serve as ideal anchorage units, particularly where a large number of teeth are missing as a result of trauma or congenital anomalies. Implants are especially valuable when the



prosthodontic positioning permits them to be used to support a future prosthesis.

Recall Program following Prosthodontic Replacement

- A. Periodic recall appointments for inspection, maintenance, repair or replacement are a necessity if maximum longevity of service is to be expected.
- B. For patients who have removable partial dentures, relining or rebasing should be performed when indicated.
- C. When jacket crowns or metal ceramic restorations are used in adolescents, replacement may be needed periodically as the gingival tissue assumes its adult positions.
- D. Patients with fixed partial dentures should be inspected periodically for soft tissue changes, evidence of occlusal wear and response of the supporting tissues to the added stress loads.

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Chapter 24



Oral Pathologic Considerations in Children

1. Disorders of Tongue
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 - Pre-eruptive caries
 - Intrinsic stains
 - Mucocele
 - Ranula
 - Recurrent aphthous stomatitis



Oral pathologic conditions can be discussed based on the tissue/ organ involved.

DISORDERS OF THE TONGUE

Microglossia

- It is an uncommon developmental anomaly of the tongue featuring an abnormally small tongue
- In rare cases, almost the whole tongue may be absent/missing. This is called aglossia
- Microglossia is frequently associated with hypoplasia of the mandible and the lower incisors may be missing. It may also be associated with constricted arch and posterior cross bite
- Treatment includes surgical correction followed by orthodontic treatment of dental defects.

Macroglossia

- Macroglossia refers to a tongue that is larger than normal
- This condition may be either congenital or acquired in type
- Congenital macroglossia, which is caused by an overdevelopment of the lingual musculature or vascular tissues, becomes increasingly apparent as the child develops
- An abnormally large tongue is characteristic of hypothyroidism, in which case the tongue is fissured and may extend out of the mouth
- Macroglossia is also commonly observed with type II glycogen storage disease, neurofibromatosis type I, and Beckwith-Wiedemann syndrome
- It can be an isolated and sporadic (nonfamilial) trait or can be a familial (autosomal dominant) trait
- A disproportionately large tongue may cause both an abnormal growth pattern of the jaw and malocclusion. Flaring of the lower anterior teeth and an Angle class III malocclusion are occasionally the result of macroglossia
- In infants, the large tongue is always seen protruding, causing inability to close the mouth. Drooling of saliva, noisy breathing and inability to feed are also seen

- The treatment of macroglossia depends on its cause and severity. Surgical reduction of a portion of the tongue is occasionally necessary.

Ankyloglossia

- It is a developmental anomaly of tongue characterized by a short and thick lingual frenum, usually attached too near to the tip of the tongue (Fig. 24.1)
- Partial ankyloglossia is more common and is often called “tongue-tie”
- Complete ankyloglossia occurs as a result of fusion between tongue and floor of the mouth
- Because of the short frenum, the movement of the tongue is restricted
- This interferes with mastication, speech and other tongue functions
- It may lead to anterior open-bite because it prevents the tongue from touching the roof of the mouth during swallowing. So, it pushes against the anterior teeth during swallowing
- Stripping of the lingual gingival tissues may occur if the tongue-tie is not corrected
- Surgical reduction of the abnormal lingual frenum is indicated if it interferes with the infant's nursing.
- In the older child a reduction of the frenum should be recommended only, if local conditions warrant the treatment.



Fig. 24.1: Ankyloglossia



Fissured Tongue

- A very common condition characterized by fissures, grooves or lines on the dorsal surface of the tongue
- Etiology is uncertain, may be hereditary
- Dorsal tongue surface exhibits multiple grooves or fissures that range from 2 to 6 mm in depth
- Numerous fissures divide the tongue surface into multiple islands, which seem to be separated from each other by these grooves
- Most patients exhibit a large central fissure, with smaller fissures branching outward at right angles (Fig. 24.2)
- Some patients complain of burning sensation and soreness especially on taking spicy food
- This also occurs as part of the Melkerssen-Rosenthal syndrome
- Treatment is not required. Tooth brushes can be used to clean the fissures, to prevent accumulation of food—debris between the fissures.

Median Rhomboid Glossitis

- It is a congenital abnormality of tongue, due to failure of tuberculum impar to withdraw before the fusion of the lateral halves of the tongue. So, a structure devoid of papilla is interposed between the 2 halves
- Theories suggesting etiology of fungal infection by *Candida albicans* have also been put forward
- Appears rhomboid or avoid shaped, smooth, reddish patch seen in the midline on the dorsal surface of



Fig. 24.2: Fissured tongue

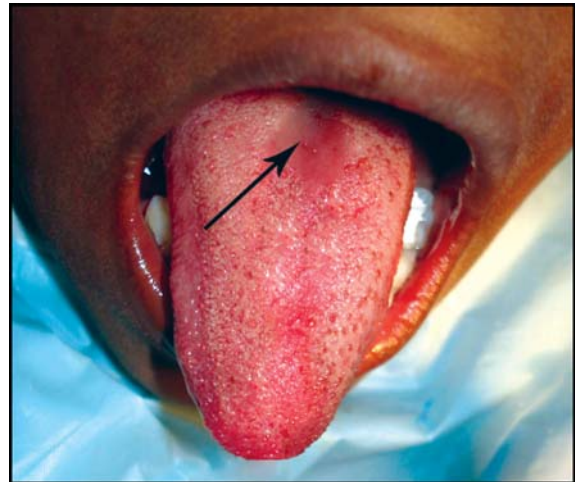


Fig. 24.3: Median rhomboid glossitis

the tongue, immediately anterior to the circumvallate papillae (Fig. 24.3)

- It stands out distinct from other areas of tongue because it has no filiform papillae (atrophied)
- Treatment includes antifungal medication if candidal infection is present. Otherwise no treatment is required.

Benign Migratory Glossitis

- A lesion of unknown etiology, characterized by migrating patches on the tongue surface
- Shown to be stress-related. Male to female ratio = 1:2, more in 5 to 18 years of age
- Shows multiple areas of desquamation of filiform papillae, in an irregular or circinate pattern
- The central portion of the lesion is inflamed, while the outer part is thin and outlined by a yellowish-white band
- The desquamated areas show fungiform papillae as red elevated dot
- The areas of desquamation remain for a short period in one location, heal and then reappear at another location. Thus it appears to migrate, traveling the whole geography of the tongue
- Frequently recurs, after spontaneous healing
- Known to occur with fissured tongue
- Certain similar lesions can occur at other locations in the oral cavity like buccal mucosa, gingiva, lips etc. They are called ectopic geographic tongue.



Hairy Tongue

- Etiology of hairy tongue is attributed to candidiasis infection and may not exactly be a developmental anomaly
- Characterized by hypertrophy of filiform papillae, with lack of normal desquamation
- This results in thickly matted and extensive filiform papillae on the dorsal surface
- Their color depends on extrinsic factors like tobacco, pan, etc. and may eventually become blackish brown.
- In severe cases, these papillae will brush the palate, producing gagging
- The entire tongue (dorsal surface) appears hairy
- Treatment is mainly concerned at keeping the tongue clean with toothbrush to avoid food accumulation and irritation.

Lingual Thyroid

- Seen in the second decade and more in females
- Characterized by a nodular enlargement with smooth or vascular surface located in the midline at the base of the tongue
- Develop during puberty or pregnancy and normal thyroid tissue may be absent
- If it is symptomatic, excision and thyroid hormone replacement is the choice of treatment.

DISORDERS OF THE BUCCAL MUCOSA

Fordyce's Granules

- A developmental anomaly characterized by a heterotopic/ectopic collections of sebaceous glands at various sites on the oral mucosa
- During the development of maxillary and mandibular process, some portion of the ectoderm from the neighbouring skin may get included in these sites, thereby leading to the development of sebaceous glands inside the mouth
- Appear as multiple yellowish-white papules
- Most common on buccal mucosa (Also seen on vermilion border of upper lip, tonsils, etc.)
- May have a granular appearance of cheek mucosa because of many papules

- Since they are asymptomatic, no treatment is indicated.

Leukoedema

- Common condition of oral mucosa, characterized by white, milky and opalescent appearance of the oral mucosa
- Unknown etiology. Known to occur more in blacks than whites
- Most common on cheek, producing grayish-white, milky and opalescent appearance of mucosa
- Surface of the mucosa appears folded, leading to wrinkles or white streaks
- The lesions cannot be scraped off
- Typically bilateral, may extend on to the lip mucosa.
- When the cheek is stretched or tensed, the white patch tends to disappear
- Leukoedema is not a pre-malignant condition and does not have malignant potential
- No treatment needed.

Focal Epithelial Hyperplasia

- A condition of the oral mucosa presenting as nodular lesions, commonly on lower lip and buccal mucosa.
- May also occur on upper lip, gingiva, commissures, etc.
- Nodular, 1 to 5 mm in size with sessile base
- Soft and is of the same color as the mucosa
- Children between 3 and 18 years more affected
- May undergo regression after 6 months
- No treatment is necessary as the lesions are harmless.

DISORDERS OF THE LIPS

Commissural Lip Pits

- They are small mucosal invaginations that occur at the corners of the mouth on the vermilion borders of lips
- Many represent a failure of normal fusion of the embryonic maxillary and mandibular processes
- More common in adults, (12-20%), while it is less in children (0.2-0.7%)
- Though they are congenital, the actual pits may develop later in life.



- Seen more in males
- May be unilateral or bilateral
- Asymptomatic
- Some of them produce fluid, when squeezed. These may represent minor salivary glands that drain into their depths
- Not associated with any clefts of face or palate.
- No treatment required.

Double Lip

- Rare oral anomaly featured by a fold of tissue on the mucosal side of the lip
- Often congenital in origin; may be acquired also
- Upper lip is much more affected
- Both lips are rarely involved together
- Condition becomes noticeable when lips are tensed/ stretched like smiling, etc.
- No treatment required.

Cleft Lip

- Forms one of the two important components of orofacial clefts (cleft lip + cleft palate)
- Formed due to defective or failure of fusion of the median nasal process with the maxillary process
- Frequently occurs along with cleft palate
- They may occur singly (isolated) or, as part of syndromes (as many as 250 syndromes are identified)
- Classification:
 - Unilateral incomplete
 - Unilateral complete
 - Bilateral incomplete
 - Bilateral complete (also called “hare lip”)
- The incomplete clefts extend towards the nostril and involves the palate
- The complete clefts extends into the nostril and even more commonly involves the palate
- Combined clefts are more frequent and severe in boys. They more frequently occur on left side
- For detailed discussion—refer chapter 19.

Peutz-Jegher's Syndrome

- Consists of familial intestinal polyposis, pigmented spots on the face, oral cavity, hands and feet
- Melanin pigmentation of lips and oral mucosa is present at birth
- Appears as small brown macules measuring 1 to 5 mm in diameter

- Intraorally, buccal mucosa is mostly involved, followed by hard palate and gingiva
- Tongue rarely shows pigmentation
- Mucosal surface of lower lip is very largely involved.
- The facial pigmentation may fade later in life, but mucosal pigmentation of lip and buccal mucosa persists
- Intestinal polyps are usually distributed through the entire intestine, but are more in small intestine
- Thus, many patients have abdominal pain and signs of minor obstruction
- This syndrome is not sex linked, since both sexes are equally affected and both males and females carry the factor
- Diagnosis is often first made by dentists, through the oro-facial pigmentations.

DISORDERS AFFECTING THE SHAPE OF THE TEETH

Microdontia

- This term is used to describe teeth that are smaller than normal.
- They are of three types:
 - *True generalized*—All teeth are smaller than normal. It is a rare condition where all the teeth are well formed but merely small
 - *Relative generalized*—The teeth are of normal or slightly smaller size that are present in jaws that are somewhat larger than normal and therefore giving an illusion of microdontia. It is due to jaw and tooth size discrepancy and the role of hereditary is obvious
 - *Microdontia of single tooth*—A common condition affects most often maxillary lateral incisor and third molar. Most common form is the peg lateral.

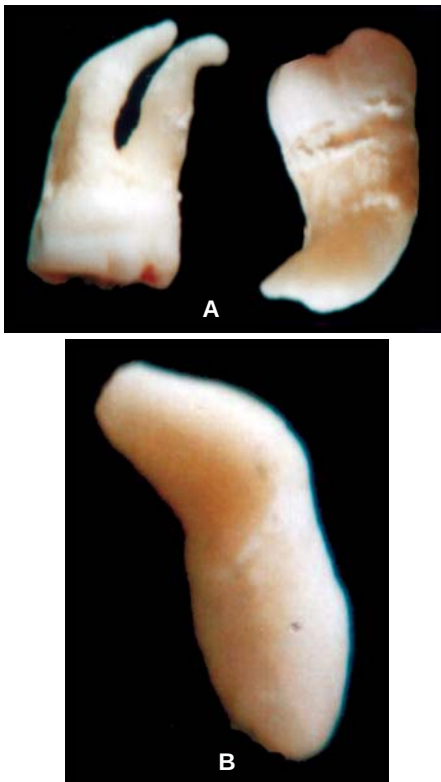
Macrodonia

- Refers to teeth larger than normal
- They are of three types:
 - *True generalized*: All the teeth are larger than normal. A rare condition associated with pituitary gigantism
 - *Relative generalized*: It is more common. Larger than normal teeth in smaller jaws, where hereditary plays a role
 - *Macrodonia of a single tooth*: Relatively uncommon, unknown etiology.



Dilaceration

- It refers to an angulation or a bend in the crown or root of a formed tooth (Fig. 24.4)
- Occurs due to trauma during the period in which tooth is forming with the result that the resultant tooth is calcified in the new position
- The bend may occur anywhere along the length of the root
- The concern is the problems that may arise during extraction or endodontic therapy.



Figs 24.4: Dilaceration: (A) Posterior teeth; (B) Anterior teeth

Talons Cusp

- It is a small elevated structure resembling an Eagle's talon, projecting from the cingulum of a maxillary or a mandibular permanent incisor (Fig. 24.5)
- This cusp blends smoothly with the tooth structure except that there is a deep development groove where the cusp blends with the sloping lingual tooth surface
- Composed of normal enamel and dentin and contains a horn of pulp tissue

- Problems of esthetics, caries, occlusal interference
- More prevalent in persons with Rubinstein-Taybi syndrome.



Fig. 24.5: Talons cusp seen on the maxillary left lateral incisor

Dens Evaginatus

- Appears clinically as an accessory cusp or a globule of enamel on occlusal surface between the buccal and lingual cusp of mandibular premolars
- Unilateral or bilateral in occurrence
- Rarely seen on molars, canines or incisors
- There is evagination of an area of inner enamel epithelium
- The extra-cusp may contribute to incomplete eruption, displacement of teeth and/or pulp exposure with subsequent infection following fracture or wear of surface.

Dens in Dente

- This developmental anomaly has been described as a lingual invagination of the enamel
- This condition can occur in primary and permanent teeth
- It is most often seen in the permanent maxillary lateral incisors
- The condition may be inherited as an autosomal dominant trait with variable expressivity and possibly incomplete penetrance
- Anterior teeth with dens in dente are usually of normal shape and size. In other areas of the mouth, however, the tooth can have an anomalous appearance
- A dens in dente is characterized by an invagination lined with enamel and the presence of a foramen caecum with the probability of a communication between the cavity of the invagination and the pulp chamber.



- Application of sealant or a restoration at the opening of the invagination are the recommended treatments to prevent pulpal involvement.
- If the condition is detected before complete eruption of the tooth, the removal of gingival tissue to facilitate cavity preparation and restoration may be indicated.

Taurodontism

- Anomaly in which body of the tooth is enlarged at the expense of roots (Fig. 24.6)
- The name suggests bull like teeth due to resemblance to the teeth of cud chewing animals
- May be hypo, meso or hypertaurodontism. In severe form the bifurcation or the trifurcation occurs near the apices of the roots
- Associated with Klinefelter's syndrome
- May affect deciduous or permanent teeth
- Molars invariably involved
- Clinically teeth themselves have no characteristic feature
- The clinical significance of the condition becomes apparent endodontic therapy is necessary
- Radiographically-extreme large pulp chamber, pulp lacking usual constriction at cervix.



Fig. 24.6: Taurodontism of posterior teeth

Supernumerary Roots (Figs 24.7)

- May involve any tooth
- Clinical significance lies in exodontia where extraction may cause breakage of one root acting as a focus of infection.

Fusion (Figs 24.8 and 24.9)

- Fusion represents the union of two independently developing primary or permanent teeth
- The condition is almost always limited to the anterior teeth and, may follow a familial tendency

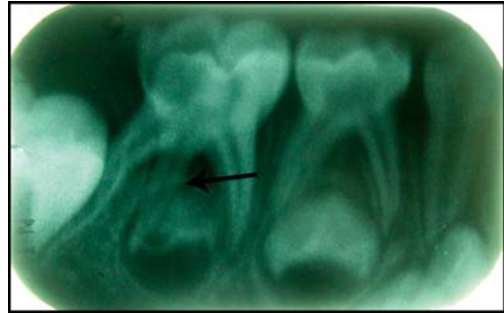


Fig. 24.7: Supernumerary root seen in the lower second deciduous molar

- The radiograph may show that the fusion is limited to the crowns and roots. Fused teeth will have separate pulp chambers and separate pulp canals
- Dental caries may develop in the line of fusion of the crowns, necessitating the placement of a restoration
- A frequent finding in fusion of primary teeth is the congenital absence of one of the corresponding permanent teeth.



Fig. 24.8: Fusion of maxillary deciduous central and lateral incisors with a supernumerary deciduous tooth. The patient had a missing permanent lateral incisor which is a common sequelae



Fig. 24.9: Fusion involving deciduous mandibular central and lateral incisors



Gemination

- A geminated tooth represents an attempted division of a single tooth germ by invagination occurring during the proliferation stage of the growth cycle of the tooth
- The anomaly, which may follow a hereditary pattern, is seen in both primary and permanent teeth, though it probably occurs more frequently in primary teeth
- The geminated tooth appears clinically as a bifid crown on a single root. The crown is usually wider than normal, with a shallow groove extending from the incisal edge to the cervical region.

Concrescence (Fig. 24.10)

- It is a form of fusion that happens after the completion of the root
- The union is only at the cementum interface
- May be due to traumatic injury or crowding of teeth, with resorption of interdental bone
- It is important to diagnose this prior to extraction, otherwise both the teeth will be removed together.



Fig. 24.10: Concrescence

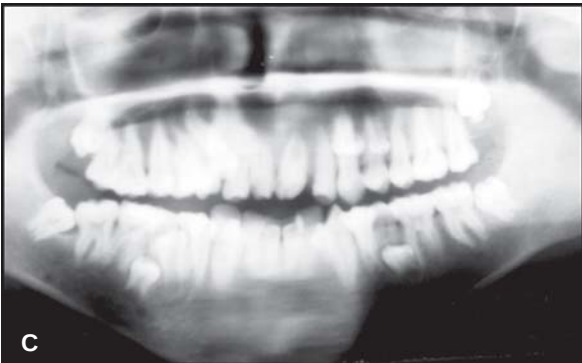
Odontome

- Epithelial and mesenchymal cells exhibit failure to differentiate resulting in abnormal formation of enamel and dentin
 - They are of two types: the compound composite odontoma and complex composite odontoma
- Compound composite odontoma resembles the anatomy of the normal teeth to a certain extent
 - Complex composite odontoma appears as an irregular mass of dental tissue and bears no resemblance to normal tooth structure
 - Etiology is unknown. May be due to trauma or infection
 - It may become large and cause facial swelling and asymmetry
 - Treatment includes surgical removal.

DISORDERS AFFECTING THE NUMBER OF TEETH

Supernumerary Teeth (Fig 24.11)

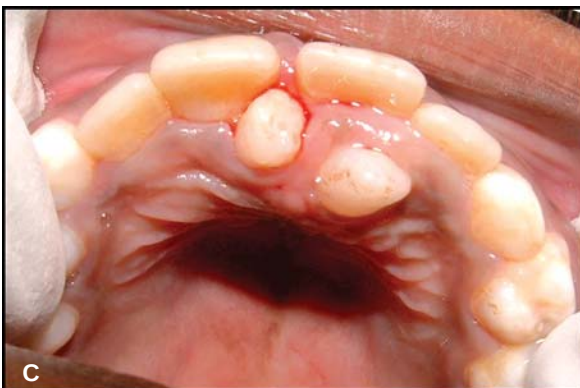
- Develops from a third tooth bud arising from the dental lamina near the permanent tooth bud, or possibly from the splitting of the permanent bud itself. In some cases a hereditary tendency has been noted
- May be found in any location, but they have an apparent predilection for certain sites
- Most common supernumerary tooth is the mesiodens (Fig. 24.12)—a tooth situated between the maxillary central incisors and occurring singly or paired, erupted or impacted or even inverted. The mesiodens are usually small teeth with a cone shaped crown and a short root. Mesiodens is transmitted as an autosomal dominant trait
- Maxillary 4th molar is the next most common supernumerary tooth and is situated distal to the third molar
- Mandibular 4th molar is less common
- Other supernumerary teeth are maxillary paramolars, mandibular premolars and maxillary lateral incisors. The paramolars are small rudimentary tooth situated buccally or lingually to one of the maxillary molars or interproximally between the first, second or third maxillary molar
- 90% of all supernumerary teeth occur in maxilla
- Supernumerary teeth in deciduous dentition are less common
- Cause of additional tooth bulk frequently cause malposition of adjacent teeth or prevent their eruption.



Figs 24.11A to C: Supernumerary teeth, 6 erupted and 6 unerupted: (A) Upper arch, (B) Lower arch, (C) Radiograph

Anodontia

- Implies complete failure of the teeth to develop
- When it occurs as an isolated trait, the primary dentition is not affected, and the inheritance is autosomal recessive
- An overlay denture is constructed for the patient, which is the treatment of choice.



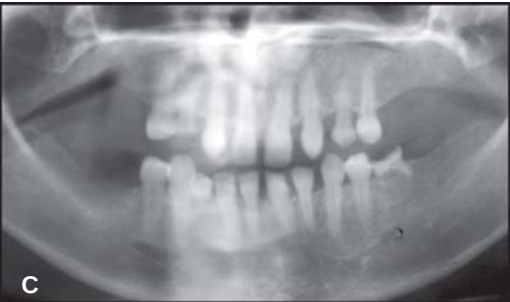
Figs 24.12A to C: Mesiodens: (A) Located inbetween the deciduous incisors, (B) Located palatal to the permanent central incisors, (C) Two mesiodens located palatally

Hypodontia

- Agenesis of some teeth is referred to as hypodontia, which is same as partial anodontia. Oligodontia is used when more than six permanent teeth are missing except the third molars
- Hypodontia may occur without a family history of hypodontia, though it is often familial
- It may also occur as a part of a syndrome, especially in ectodermal dysplasia.



- Most frequently missing teeth are the mandibular second premolars, maxillary lateral incisors (Fig 24.13), and maxillary second premolars. The absence of teeth may be unilateral or bilateral
- Management includes replacement of the missing teeth



Figs 24.13A to C: Hypodontia involving: (A) Permanent maxillary lateral incisors, (B) Permanent mandibular central incisors, (C) Multiple missing teeth

Ectodermal Dysplasia

- It is characterized by varying anomalies of ectodermal derivatives including both the primary and permanent teeth, hair, nails, and skin

- The congenital absence of primary teeth is relatively rare
- When a number of primary teeth fail to develop, other ectodermal deficiencies are usually evident
- Children with a number of missing primary and permanent teeth may have some or all of the signs of a type of ectodermal dysplasia and should undergo further evaluation for other systemic changes.

Anhidrotic Ectodermal Dysplasia (Fig. 24.14)

- It is one of the more common types of ectodermal dysplasia. Consanguinity increases the likelihood of a trait or condition that is inherited in a recessive manner to be expressed
- Hypodontia and dental hypoplasia, as well as hypotrichosis, hypo/anhidrosis are characteristic
- Secondary characteristics include a deficiency in salivary flow, protuberant lips and a saddle-nose appearance
- The skin is often dry and scaly and there is fissuring at the corners of the mouth
- The absence of teeth predisposes the child to a lack in growth of the alveolar process
- Other skeletal structures are normal
- The size of the primary teeth that are present may be normal or reduced
- The anterior teeth are often conical, which is characteristic of oligodontia associated with many types of ectodermal dysplasia
- The primary molars without permanent successors have an unexplained tendency to become ankylosed
- A deficiency in sweat glands causes a predisposition to increased body temperature, and children with hypo/anhidrosis are extremely uncomfortable during hot weather. Many of them must reside in cool climates
- Children with an ectodermal dysplasia usually have normal mental development and a normal life expectancy
- Children with a large number of missing primary teeth can have partial dentures constructed at an early age so as to increase their ability to masticate food and improve their nutritional status



- A partial denture may be adjusted or remade at intervals to allow for the eruption of permanent teeth and jaw growth
- Denture construction at an early age is desirable, to reduce the psychologic problem that may cause the child to feel “different” and to ensure masticatory efficiency
- If the permanent teeth erupt in good position and in favorable relationship to each other, partial dentures may serve until the child is old enough for implants or fixed bridgework.



Figs 24.14A to C: Anhidrotic ectodermal dysplasia: (A) Sparse hair and stretched dry skin, (B) Upper arch with congenitally missing teeth and malformed central incisor, (C) Lower arch with congenitally missing teeth

DISORDERS AFFECTING THE STRUCTURE OF THE TEETH

Enamel Hypoplasia/Enamel Hypocalcification

- Amelogenesis occurs in two stages. In the first stage, the enamel matrix forms and in the second stage, the matrix undergoes calcification. Local or systemic factors that interfere with the normal matrix formation cause enamel surface defects and irregularities called enamel hypoplasia (Figs 24.15 and 24.16). Factors that interfere with calcification and maturation of the enamel produce a condition called enamel hypocalcification
- Postnatal hypoplasia of the primary teeth is probably as common as hypoplasia of the permanent teeth, though the former usually does not occur in as severe a form. However, hypoplasia of the primary enamel that forms before birth is rare
- Enamel hypoplasia may be mild and may result in a pitting of the enamel surface or in the development of a horizontal line across the enamel of the crown. If ameloblastic activity has been disrupted for a long period, gross areas of irregular or imperfect enamel formation occur
- Enamel hypoplasia is often seen as one component of many different syndromes and may occur due to many reasons such as
 - Hypoplasia resulting from nutritional deficiencies: such as vitamins A, C, and D, calcium, and phosphorus deficiencies
 - Hypoplasia related to brain injury and neurologic defects
 - Hypoplasia associated with nephrotic syndrome
 - Hypoplasia associated with allergies
 - Hypoplasia associated with chronic pediatric lead poisoning
 - Hypoplasia caused by local infection and trauma: such as Turner's hypoplasia
 - Hypoplasia associated with cleft lip and palate
 - Hypoplasia caused by X radiation
 - Hypoplasia resulting from rubella embryopathy.

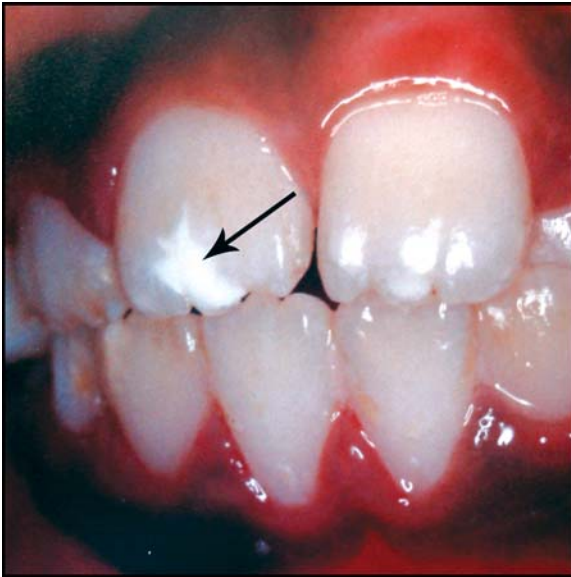


Fig. 24.15: Localized enamel hypoplasia (Arrow)



Fig. 24.16: Generalized severe enamel defect

Dentinogenesis Imperfecta (Hereditary opalescent dentin)

- Dentinogenesis imperfecta is inherited as an autosomal dominant trait. Prevalence is 1 in 8000
- The clinical picture of dentinogenesis imperfecta is one in which the primary and permanent teeth have a characteristic reddish brown to gray opalescent color
- The enamel often breaks away from the incisal edge of the anterior teeth and the occlusal surface of the posterior teeth
- The exposed soft dentin abrades rapidly, occasionally to the extent that the smooth, polished dentin surface is continuous with the gingival tissue
- The roots of teeth are short.

Amelogenesis Imperfecta

- Amelogenesis imperfecta is a developmental defect of the enamel with heterogeneous etiology that affects the enamel of both the primary and permanent dentition
- The anomaly occurs in the general population in the range of 1 in 14,000 to 1 in 16,000 and has a wide range of clinical appearances
- At least three different clinical variations of amelogenesis imperfecta are observed—the hypocalcified type, the hypomaturational type and the hypoplastic type
- The defective tooth structure is limited to the enamel.
- On radiographic examination the pulpal outline appears to be normal, and the root morphology is not unlike that of normal teeth
- The difference in the appearance and quality of the enamel is thought to be attributable to the state of enamel development at the time the defect occurs.
- The defect may be due to faulty matrix formation or calcification. When the matrix is faulty the tooth appears to be imperfectly formed with normal calcification. If the fault is in calcification the enamel becomes soft
- Treatment depends on its severity and the demands of esthetic improvement.

Dentin Dysplasia

- Dentin dysplasia is a rare disturbance of dentin formation that are of two types: radicular dentin dysplasia (type I) and coronal dentin dysplasia (type II)
- Genetic linkage has been established for dentinogenesis imperfecta.

Dentin Dysplasia (Type I)

- Both primary and secondary dentitions are affected in dentin dysplasia, type I, which is an autosomal dominant trait.
- Radiographically the roots are short and may be more pointed than normal, usually with absence of the root canals and pulp chambers
- The color and general morphology of the crowns of the teeth are usually normal, although they may be slightly opalescent and blue or brown.
- Periapical radiolucencies may be present at the apices of affected teeth.



Dentin Dysplasia (Type II)

- It is inherited as an autosomal dominant trait in which the primary dentition appears opalescent
- Radiographs show obliterated pulp chambers
- The permanent dentition in dentin dysplasia, type II has normal color
- Radiograph exhibits a thistle tube pulp configuration with pulp stones.

BENIGN TUMORS OF THE ORAL CAVITY

Hemangioma

- Seen during the first decade of life and more in females
- Commonly occurring on the lips, tongue and buccal mucosa
- They are localized to diffuse, red-blue lesion
- They are flat, nodular and soft
- Surgical excision or cryotherapy is the treatment of choice.

Lymphangioma

- Seen during the first decade with no gender predilection
- Commonly located on the tongue, lip, buccal mucosa, floor of the mouth and the neck
- Seen as localized to diffuse red- blue to translucent enlargement
- There may be multiple lesions
- Treatment of choice is excisional biopsy. Regression is rare.

Congenital Epulis

- Seen in newborn and more in females
- Located commonly in the anterior maxillary alveolar ridge area
- It appears as smooth, pedunculated swelling
- Treatment is excision.

Neurofibromatosis

- 7% of the lesions are seen in oral cavity, rest are spread throughout the body

- Appears as nodules of neural tissue. They may be small, discrete and smooth or even pedunculated
- No treatment is necessary.

White Sponge Nevus

- Uncommon with autosomal dominant hereditary pattern
- Buccal mucosa commonly affected
- Asymptomatic, widespread, corrugated thickening of oral mucosa
- No treatment required.

Blue Nevus

- Seen during the second decade, more in females
- Commonly occurring in the hard palate, buccal mucosa, lips and gingiva
- It is a well delineated elevated nodule, brown black or blue in color
- It is asymptomatic
- Oral lesions are under constant irritation and at risk for malignant transformation
- Treatment includes excisional biopsy.

CYSTS OF ORAL CAVITY

Primordial Cyst

- Develops before any tooth material has been formed, thus associated with a congenitally missing tooth
- Varies widely in size, with potential to expand the bone and displace the adjacent teeth
- Not painful
- X-ray shows round or ovoid, well demarcated radiolucent lesion which may show a sclerotic border
- It may be unilocular or multilocular
- Treatment includes surgical removal with thorough curettage of the bone.

Dentigerous Cyst (Follicular Cyst)

- It originates after the crown of the tooth has been completely formed by accumulation of fluid between the reduced enamel epithelium and the tooth crown.
- The most common sites of this cyst are the mandibular and maxillary third molar and maxillary cuspid areas



- The dentigerous cyst nearly always involves or is associated with the crown of a normal permanent tooth
- Seldom is a deciduous tooth involved
- May also be found enclosing a complex compound odontoma or involving a supernumerary tooth
- The lesion appears as a circumscribed, fluctuant, often translucent swelling of the alveolar ridge over the site of the erupting tooth
- X-ray shows radiolucent area associated with an unerupted tooth crown (Fig. 24.17). The dentigerous cyst is usually smooth, with unilocular or multilocular appearance
- Smaller lesions can be surgically removed in their entirety with little difficulty. The larger cysts which involve serious loss of bone and thin the bone dangerously are often treated by insertion of a surgical drain or marsupialization.

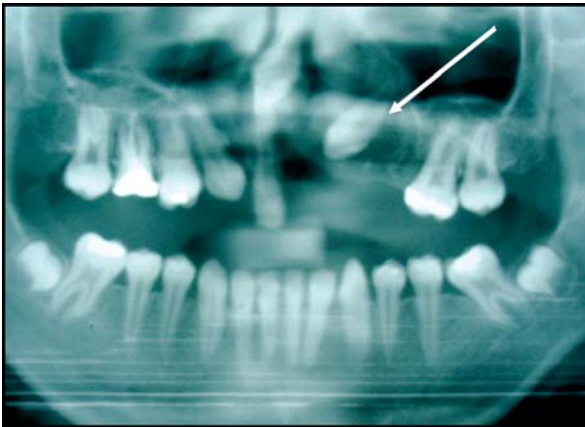


Fig. 24.17: Dentigerous cyst involving the unerupted maxillary canine (arrow)

Odontogenic Keratocyst

- Occurs in the second decade and seen more in males
- Located in the posterior body and ramus of the mandible, maxillary third molar and canine region
- It is painful
- X-ray shows well defined unilocular or multilocular radiolucency with thin opaque well demarcated border
- Can cause root resorption or displacement of adjacent roots
- Treatment includes surgical excision with curettage.

Radicular Cyst

- Wide age distribution of occurrence. Seen more in maxilla and in association with a non vital teeth
- X-ray shows round or ovoid radiolucency around the tooth apex
- Treatment includes enucleation.

Nasopalatine Duct Cyst

- Originates from the cystic dilatation of the nasopalatine duct
- It is a painless soft swelling in the incisive foramen area
- X-ray shows heart shaped radiolucency in the midline of anterior maxilla
- Treatment includes enucleation.

Globulomaxillary Cyst

- It is a fissural cyst found within bone between the maxillary lateral incisor and canine
- Treatment is enucleation.

Dental Lamina Cyst of the Newborn

(Gingival cyst of the newborn; Epstein's pearls; Bohn's nodules)

- Dental lamina cysts of the newborn are multiple, occasionally solitary, nodules on the alveolar ridge of newborn or very young infants which represent cysts originating from remnants of the dental lamina.
- Epstein's pearls are cystic, keratin filled nodules found along the midpalatine raphe
- Bohn's nodules are keratin filled cysts scattered on the hard palate especially at the junction of the hard and soft palate
- Appears clinically as small discrete white swellings of the alveolar ridge
- They are painless
- No treatment is required.

DISORDERS OF THE JAW

Agnathia

- An extremely rare congenital defect characterized by absence of maxilla or mandible



- More commonly only a portion of one jaw is missing
- Partial absence of mandible is even more common.

Micrognathia

- It is a congenital anomaly but the condition may be acquired in later life. The mandible is most often affected
- The cause of congenital micrognathia appears to be heterogeneous
- Deficient nutrition of the mother and intrauterine injury resulting from pressure or trauma have been suggested as possible etiologies
- Additionally, micrognathia may be part of the robin sequence comprised also of cleft palate and glossoptosis
- Infants with mandibular micrognathia have difficulty in breathing and episodes of cyanosis are seen
- The anterior portion of the mandible is positioned so that the tongue has little if any support and can fall backward, causing obstruction
- Because mandibular growth continues until late adolescence, it is possible to hope for an esthetically pleasing profile in adulthood
- The nursing bottle may be used in the treatment of congenital micrognathia to help promote adequate function of the mandible
- Acquired micrognathia may develop gradually and may not be evident until 4 to 6 years of age. Ankylosis of the jaw caused by a birth injury or trauma in later life may result in an acquired type of micrognathia. Infection in the temporomandibular joint area can also cause arrested growth at the head of the condyle and the acquired pattern of micrognathia develops. In cases of true ankylosis of the mandible, arthroplasty should be recommended.

Macrogathia

- Refers to condition of abnormally large jaws
- Associated with pituitary gigantism, Pagets disease, acromegaly
- Cases of mandibular prognathism are a common occurrence.
- Etiology is unknown although some cases may follow a hereditary pattern

- Factors favouring mandibular prognathism are— increased height of ramus, increased mandibular body length, increased gonial angle, anterior position of glenoid fossa, decreased maxillary length, prominent chin button.

Osteomyelitis

- Seen in the first and second decade. There is no gender predilection
- Occurs in the posterior mandibular region
- Associated with fever, periapical abscess, a carious teeth, pain and lymphadenopathy
- X-ray shows diffuse radiolucency with poorly defined margins
- Treatment includes incision and drainage followed by treatment of carious teeth.

Fibrous Dysplasia

- Seen in the first and second decade, with no gender predilection
- Maxilla is commonly affected
- Characterized by expansion of buccal cortical plate which is unilateral and asymptomatic
- X-ray shows radiolucent to densely opaque lesion. Ground glass appearance is the characteristic feature of fibrous dysplasia
- Treatment is not required.

Cherubism

- Autosomal dominant mode of transmission
- Manifests early in childhood
- Painless, progressing, symmetric swelling of the jaws affecting mandible or maxilla producing a typical chubby face
- Deciduous dentition may be spontaneously shed prematurely
- Permanent dentition may be defective
- X-ray shows bilateral destruction of bone with expansion and thinning of the cortical plate
- They regress with age. Correction other than for cosmetic reasons are not required.

DISORDERS OF THE FACE

Facial Hemihypertrophy

- Exhibit enlargement of one half of head and face



- Etiology may be attributed to hormonal imbalance, incomplete twinning, localized alteration of intrauterine development, chromosomal abnormalities, lymphatic, vascular and neurogenic abnormalities
- There appears to be some relationship between hemihypertrophy and neoplasms of kidney, liver and adrenal cortex in children
- Females are affected more
- Permanent teeth on affected sides are enlarged, develop more rapidly and erupt before their counter parts on uninvolved side
- Roots of teeth are short
- Bone of maxilla and mandible are also enlarged
- Tongue may show enlargement of lingual papillae.
- Caused by infection with streptococcal organisms of the beta hemolytic type that elaborate an erythrogenic toxin.
- Incubation period is of three to five days
- The patient then exhibits severe pharyngitis and tonsillitis, headache, chills, fever and vomiting. Accompanying these symptoms are enlargement and tenderness of the regional cervical lymph nodes
- Diffuse, bright scarlet skin rash appears on the second or third day of the illness. This rash, which is particularly prominent in the areas of the skin folds, is a result of the toxic injury to the vascular endothelium which produces dilatation of the small blood vessels and consequent hyperemia
- The mucosa, particularly of the palate, may appear congested, and the throat is often fiery red
- The tonsils and faucial pillars are usually swollen and sometimes covered with a grayish exudate
- More important are the changes occurring in the tongue. Early in the course of the disease the tongue exhibits a white coating, and the fungiform papillae are edematous and hyperemic projecting above the surface as small red knobs. This phenomenon has been described clinically as a “strawberry tongue”
- The coating of the tongue is soon lost, beginning at the tip and lateral margins, and the tongue becomes deep red, glistening and smooth except for the swollen, hyperemic papillae. The tongue in this phase has been termed the “raspberry tongue”
- The skin then desquamates within a week or 10 days
- The disease is treated by antibiotic therapy.

Facial Hemiatrophy

- It is a progressive atrophy of some or all tissues of one side of face
- Etiology can be attributed to malfunction of sympathetic nervous system, trauma, infection, heredity, localised scleroderma
- Noticed in first or second decade as a white line or furrow on side of face or brow near midline
- Lesion extends to include atrophy of skin, muscle, bone, tissue
- Hollowing of cheek and eyes may appear depressed in orbit
- Response of atrophic facial muscles to faradic stimulation is unaltered
- Affected skin is darkly pigmented
- Loss of facial hair is common
- Hemiatrophy of lips and tongue is reported
- Growth of teeth may be affected
- Roots of teeth may exhibit deficiency of root development
- Eruption on affected side may be retarded.

BACTERIAL INFECTIONS

Scarlet Fever (Scarlatina)

- Occurs predominantly in children during the winter months

Diphtheria

- It is an acute contagious disease caused by a gram-positive bacillus, *Corynebacterium diphtheriae*, or the Klebs-Loeffler bacillus
- This infection occurs most frequently in children during the fall and winter months
- The disease is transmitted through droplet infection or by direct contact
- The incubation period for diphtheria is only a few days
- The disease is manifested initially by listlessness, malaise, headache, fever and occasional vomiting.



- It may be associated with sore throat, mild redness and edema of the pharynx and cervical lymphadenopathy
- Patchy “diphtheritic membrane” is seen on the tonsils, which later enlarges and becomes confluent over the surface. This membrane is grayish, thick, fibrinous, gelatinous-appearing exudate which contains dead cells, leukocytes and bacteria overlying necrotic, ulcerated areas of the mucosa and covering the tonsils, pharynx and larynx. It tends to be adherent and leaves a bleeding surface if stripped away
- If the infection spreads unchecked in the respiratory tract, the larynx may become edematous and covered by the pseudomembrane and produces a mechanical respiratory obstruction
- The disease may be prevented by prophylactic active immunization with diphtheria toxoid
- Once the disease has developed, it is treated with antitoxin, usually in combination with antibiotics.
- The usual tuberculous lesion is an irregular, superficial or deep, painful ulcer which tends to increase slowly in size
- The dentist may contract an infection from his contact with living tubercle
- Bacilli in the mouths of patients who have pulmonary or oral tuberculosis is a problem of great clinical significance
- Tuberculous gingivitis is an unusual form of tuberculosis which may appear as a diffuse, hyperemic, nodular or papillary proliferation of the gingival tissues
- Tuberculosis may also involve the bone of the maxilla or mandible. Tuberculous osteomyelitis frequently occurs in the later stages of the disease and has an unfavorable prognosis
- The treatment of oral tuberculosis is secondary to treatment of the primary lesions.

Tuberculosis

- Tuberculosis is an infectious granulomatous disease caused by the acid-fast bacillus *Mycobacterium tuberculosis*
- Pulmonary tuberculosis is the chief form of the disease, although infection may also occur by way of the intestinal tract, tonsils and skin
- Tuberculous infection of submaxillary and cervical lymph nodes, or scrofula, a tuberculous lymphadenitis, may progress to the formation of an actual abscess or remain as a typical granulomatous lesion. They are tender or painful, often show inflammation of the overlying skin
- Tuberculous lesions of the oral cavity do occur secondary to a pulmonary disease
- The organisms are carried in the sputum and enter the mucosal tissue through a small break in the surface
- Lesions may occur at any site on the oral mucous membrane, but the tongue is most commonly affected, followed by the palate, lips, buccal mucosa, gingiva and frenula
- Actinomycosis is a chronic granulomatous, suppurative, and fibrosing disease caused by anaerobic, gram-positive, nonacid-fast, filamentous bacteria, *Actinomyces israelii*, although *A. naeslundii*, *A. viscosus*, *A. odontolyticus* and *A. propionica*
- The usual pattern of this disease is one characterized chiefly by the formation of abscesses which tend to drain by the formation of sinus tracts
- If the pus from the abscesses is carefully examined on a clean glass slide, it shows the typical “sulfur granules,” or colonies of organisms which appear in the suppurative material as tiny yellow grains
- Actinomycosis is classified anatomically according to the location of the lesions, and thus we recognize (i) cervicofacial, (ii) abdominal, and (iii) pulmonary forms
- Cervicofacial actinomycosis is the most common form of this disease and is of greatest interest to the dental professionals
- It involves the salivary glands, bone or even the skin of the face and neck, producing swelling and induration of the tissue. These soft tissue swellings eventually develop into one or more abscesses which



tend to discharge upon a skin surface, rarely a mucosal surface, liberating pus containing the typical “sulfur granules”

- The skin overlying the abscess is purplish red and indurated or often fluctuant
 - The infection of the soft tissues may extend to involve the mandible or, less commonly, the maxilla. If the bone of the maxilla is invaded, the ensuing specific osteomyelitis may eventually involve the cranium, meninges or the brain itself
 - The treatment of this disease is difficult and has not been uniformly successful. Penicillin and tetracyclines have been used most frequently, but the course of the disease is still often prolonged.
- Short maxilla
 - High palatal arch
 - Saddle nose
 - Mulberry molars
 - Irregular thickening of the sternoclavicular portion of the clavicle
 - Relative protuberance of mandible
 - Rhagades
 - aber shin
 - Hutchinson's triad consisting of hypoplasia of the incisor and molar teeth, eighth nerve deafness and interstitial keratitis.
- Adequate treatment of the mother before 16th week of gestation.

Tetanus (Lock-jaw)

- Tetanus is a disease of the nervous system characterized by intense activity of motor neurons and resulting in severe muscle spasms.
- It is caused by the exotoxin of the anaerobic gram positive bacillus *Clostridium tetani*
- Clinical manifestations consist of pain and stiffness in the jaws and neck muscles, with muscle rigidity producing trismus and dysphagia
- Rigidity of facial muscles may also occur, producing the typical “risus sardonicus”
- “Cephalic tetanus” is tetanus which is either localized or generalized, occurring in association with cranial nerve palsy, most commonly the seventh cranial nerve
- All patients with the disease should receive antimicrobial drugs, active and passive immunization, surgical wound care.

Syphilis

- Syphilis is caused by infection with a spirochete, *Treponema pallidum*
- Syphilis may be classified as either acquired or congenital
- Congenital syphilis is transmitted to the offspring only by an infected mother and is not inherited.
- Manifestation of congenital syphilis are
 - Frontal bossae

Noma (Cancrum Oris)

- Noma is a rapidly spreading gangrene of the oral and facial tissues that occurs usually in debilitated or nutritionally deficient persons
- Thus noma may be considered a secondary complication of systemic disease rather than a primary disease
- It is seen chiefly in children
- Noma appears to originate as a specific infection by Vincent's organisms, an acute necrotizing gingivostomatitis, which is soon complicated by secondary invasion of many other microbial forms, including streptococci, staphylococci and diphtheria bacilli
- Noma usually begins as a small ulcer of the gingival mucosa which rapidly spreads and involves the surrounding tissues of the jaws, lips and cheeks by gangrenous necrosis
- The odor arising from the gangrenous tissues is extremely foul. The palate and occasionally the tongue may become involved by this process, but this is not common. Patients have a high temperature during the course of the disease, suffer secondary infection and may die from toxemia or pneumonia
- The mortality rate of noma approximated 75 per cent before the availability of antibiotics
- The prognosis is considerably better if antibiotics are administered before the patient reaches the final



stages. Immediate treatment of any existing malnutrition further improves the probability of saving the patient.

Pyogenic Granuloma (*Granuloma pyogenicum*)

- The pyogenic granuloma is a distinctive clinical entity originating as a response of the tissues to a nonspecific infection either staphylococci or streptococci, usually triggered by local irritation
- Occurs most frequently on the gingiva, but may also be found on the lips, tongue and buccal mucosa and occasionally on other areas
- The lesion is usually an elevated, pedunculated or sessile mass with a smooth, lobulated or even a warty surface which commonly is ulcerated and shows a tendency for hemorrhage either spontaneously or upon slight trauma
- Treatment includes removal of the irritant and oral hygiene measures.

VIRAL INFECTIONS

Herpes Simplex Virus Type I Infection

- Caused by the herpes simplex virus (HSV)
- Herpetic stomatitis is a common oral disease which develops in both children and young adults
- It rarely occurs before the age of six months, apparently because of the presence of circulating antibodies in the infant derived from the mother.
- The disease occurring in children is frequently the primary attack
- It is characterized by the development of fever, irritability, headache, pain upon swallowing and regional lymphadenopathy
- Within a few days the mouth becomes painful and the gingiva intensely inflamed
- The lips, tongue, buccal mucosa, palate, pharynx and tonsils may also be involved
- Shortly, yellowish, fluid-filled vesicles develop. These rupture and form shallow, ragged, extremely painful ulcers covered by a gray membrane and surrounded by an erythematous halo
- They heal spontaneously within 7 to 14 days and leave no scar

- Treatment is symptomatic such as application of topical anesthetic agents on the ulcers, soft diet and adequate fluids.

Herpangina

- Herpangina is a specific viral infection
- Coxsackie group A viruses are the cause of the disease
- It is most commonly seen in young children; older children and adults are only occasionally affected.
- Herpangina is chiefly a summer disease, and many children may actually harbor the virus at this time without exhibiting clinical manifestations of the disease
- This disease appears to be transmitted from one person to another through contact and multiple cases in a single household are common
- The incubation period is about 2 to 10 days
- The clinical manifestations of herpangina are comparatively mild and of short duration
- It begins with sore throat, low-grade fever, headache, sometimes vomiting, prostration and abdominal pain
- The patients soon exhibit small vesicles which are present for a short duration of time that later ulcerates, each showing a gray base and an inflamed periphery on the anterior faucial pillars and sometimes on the hard and soft palates, posterior pharyngeal wall, buccal mucosa and tongue
- The ulcers do not tend to be extremely painful, although dysphagia may occur. They generally heal within a few days to a week
- A permanent immunity to the infecting strain usually develops rapidly
- No treatment is necessary, since the disease appears to be self-limiting and presents few complications.

Measles (*Rubeola*)

- Measles is an acute, contagious, dermatropic viral infection, primarily affecting children and occurring many times in epidemic form
- Spread of the disease occurs by direct contact with an affected person or by droplet infection, the portal of entry being the respiratory tract



- The disease has an incubation period of 8 to 10 days
- Characterized by the onset of fever, malaise, cough, conjunctivitis, photophobia and lacrimation. Eruptive lesions are seen on the skin and oral mucosa that appear as tiny red macules or papules which enlarge and coalesce to form blotchy, discolored, irregular lesions which blanch upon pressure. They gradually fade away in four to five days with a fine desquamation
- The oral lesions frequently occur two to three days before the cutaneous rash, and are pathognomonic of this disease
- The intraoral lesions are called as Koplik's spots which is a characteristic feature of measles, usually occurring on the buccal mucosa. They are small, irregularly shaped flecks which appear as bluish, white specks surrounded by a bright red margin.
- It is an extremely painful disease characterized by inflammation of dorsal root ganglia or extra-medullary cranial nerve ganglia, associated with vesicular eruptions of the skin or mucous membranes in areas supplied by the affected sensory nerves
- It is now believed that a primary infection by the V-Z virus, results clinically in chickenpox, while a recurrent infection results clinically in herpes zoster
- Initially, the adult patient exhibits fever, a general malaise and pain and tenderness along the course of the involved sensory nerves and is usually unilaterally. Within a few days the patient has a linear papular or vesicular eruption of the skin or mucosa supplied by the affected nerve
- The triggering factors initiating the onset of an attack of herpes zoster are varied and may include trauma, development of malignancy or tumor involvement of dorsal root ganglia, local X-ray radiation or immunosuppressive therapy
- Herpes zoster may involve the face by infection of the trigeminal nerve
- The newer anti-viral drugs are now under intensive clinical testing for potential effectiveness in the treatment of herpes zoster.

Chickenpox (Varicella)

- Chickenpox is an acute viral disease, usually occurring in children and most common in the winter and spring months
- It is caused by herpes-varicella-zoster virus
- The incubation period is approximately two weeks
- The mode of transmission is by airborne droplets or direct contact with infected lesions, with the probable portal of entry being the respiratory tract
- The disease is characterized by the prodromal occurrence of headache, nasopharyngitis and anorexia, followed by maculopapular or vesicular eruptions of the skin and low-grade fever. These eruptions usually begin on the trunk and spread to involve the face and extremities
- Small blister-like lesions occasionally involve the oral mucosa, chiefly the buccal mucosa, tongue, gingiva and palate, as well as the mucosa of the pharynx
- The lesion is a slightly raised vesicle with a surrounding erythema, that ruptures soon after formation to form small eroded ulcers with a red margin
- Management is symptomatic by application of topical anesthetic gel and mouth rinses.
- Mumps is an acute, contagious, viral infectious disease characterized chiefly by unilateral or bilateral swelling of the salivary glands, usually the parotid
- Mumps has an incubation period of two to three weeks
- The disease is usually preceded by the onset of headache, chills, moderate fever, vomiting and pain below the ears
- These symptoms are followed by a firm, rubbery or elastic swelling of the salivary glands, frequently elevating the ear, which lasts for about one week.
- Management includes adequate rest and fluid intake.

Mumps (Epidemic Parotitis)

Herpes zoster (Shingles)

- Herpes zoster is an acute viral infectious disease caused by herpes-varicella-zoster virus
- AIDS—Acquired Immuno Deficiency Syndrome
- Caused by human immunodeficiency virus (HIV)
- About 1/3 rd to half the number of HIV positive babies are born to mothers who are infected with HIV



- Virus transmission may occur to the fetus in pregnancy as early as the first trimester but infection is more common perinatally
- Many of the infected children may not survive for a year
- Children may also get the infection from blood transfusion or blood products
- Children develop humoral immunodeficiency early, leading to recurrent bacterial infection
- In children abnormal b cell function is seen prior to T cell abnormality. T4 helper cells that play a vital role in the induction and evolution of a normal immune response is destroyed by direct or indirect cytopathic mechanisms of HIV. They also interfere in the production of interferons. All these lead to greater susceptibility to opportunistic infections, increased propensity towards malignancy, thrombocytopenia, etc.
- Direct effect of the virus on CNS may lead to progressive encephalopathy with cognitive, behavioural and motor deficits
- Failure to thrive, chronic diarrhoea, lymphadenopathy, tuberculosis and opportunistic bacterial infections are common manifestations
- Lymphocytic interstitial pneumonia is most commonly seen in children, while kaposi sarcoma, toxoplasmosis and cryptococci are less common
- The typical findings in children include pulmonary lymphoid hyperplasia, salivary gland enlargement, pyogenic bacterial infection, developmental delay, dysmorphic craniofacial features
- Oral features includes oral candidiasis, herpes simplex virus infection, recurrent aphthous ulcerations, rapidly progressive periodontal disease, parotitis, oral hairy leukoplakia, petechiae, linear gingival erythema, cervical lymphadenopathy
- Specific tests for HIV infection are antigen detection, virus isolation, polymerase chain reaction, antibody detection tests like ELISA and western blot
- Symptomatic antiviral drugs—interferons, acyclovir, etc.

FUNGAL INFECTION

Acute Pseudomembranous Candidiasis (Thrush)

- Prone to occur in the debilitated or the chronically ill or in infants
- The oral lesions are characterized by the appearance of soft, white, slightly elevated plaques most frequently occurring on the buccal mucosa and tongue, but also seen on the palate, gingiva and floor of the mouth
- The white plaque can usually be wiped away with gauze, leaving either a relatively normal appearing mucosa or an erythematous area
- Treatment includes application of antifungal medicines such as nystatin, amphotericin B, etc.

OTHERS

Pre-eruptive "Caries"

(Pre-eruptive coronal resorption or pre-eruptive intracoronary radiolucency)

- Etiology is unknown
- These are defects on the crowns of developing permanent teeth that are evident radiographically, without infection of the primary tooth or the surrounding area
- Such a lesion does resemble caries when it is observed clinically, and the destructive nature of the lesion progresses if it is not restored
- As soon as the lesion is reasonably accessible, the tooth should be uncovered by removal of the overlying primary tooth or by surgical exposure. The caries like dentin is then excavated, and the tooth is restored with amalgam or a durable temporary restorative material. In some cases the lesion may be so extensive that indirect pulp therapy is justified.

Intrinsic Stains

- The primary teeth occasionally have unusual pigmentation. Factors causing these include blood borne pigment, blood decomposition within the pulp and drugs. Other causes of intrinsic staining are:
 1. Erythroblastosis fetalis



2. Porphyria
3. Cystic fibrosis
4. Tetracycline therapy.

Discoloration in Erythroblastosis Fetalis

- Erythroblastosis fetalis results from the transplacental passage of maternal antibody active against red blood cell antigens of the infant, leading to an increased rate of red blood cell destruction
- It is a significant cause of anemia and jaundice in newborn infants despite the development of a method of prevention by Rh antigens
- An infant from an Rh-negative mother's first pregnancy rarely contracts this hemolytic disease.
- If an infant has had severe, persistent jaundice during the neonatal period, the primary teeth may have a characteristic blue-green color, though in a few instances brown teeth have been observed. The color of the pigmented tooth is gradually reduced. The fading in color is particularly noticeable in the anterior teeth.

Discoloration in Porphyria

- It is a rare genetic disturbance of porphyria metabolism occurring in humans and animals
- Characterized by the excessive production of pigments in the body
- The condition is often observed at birth, or it may develop during infancy
- Children with congenital porphyria have red colored urine, are hypersensitive to light and develop blisters on their hands and face
- Their teeth are purplish brown as a result of the deposition of porphyrin in the developing structures.
- In congenital porphyria the permanent teeth also show evidence of intrinsic staining.

Discoloration in Cystic Fibrosis

- A high percentage of children with cystic fibrosis have teeth that are dark in color, ranging from yellowish gray to dark brown
- Patients afflicted with cystic fibrosis are usually subjected to large amounts of tetracyclines during

childhood which may also contribute for the color change seen.

Discoloration in Tetracycline Therapy

- Children who have received tetracycline therapy during the period of calcification of the primary or permanent teeth show a degree of pigmentation of the crowns of the teeth
- Tetracyclines chelate calcium salts and the drug is incorporated into bones and teeth during calcification and will be deposited in the dentin and to a lesser extent in the enamel of teeth that are calcifying during the time the drug is administered
- The crowns of affected teeth are discolored, ranging from yellow to brown and from gray to black
- The tooth fluoresce under ultraviolet light
- The exposure of the teeth to light results in slow oxidation, with a change in color of the pigment from yellow to brown
- Because tetracyclines can be transferred through the placenta, the crowns of the primary teeth may also show noticeable discoloration if tetracyclines are administered during pregnancy
- The critical period for tetracycline-related discoloration in the primary dentition is 4 months in utero to 3 months post partum for maxillary and mandibular incisors and 5 months in utero to 9 months postpartum for maxillary and mandibular canines
- The sensitive period for tetracycline-induced discoloration in the permanent maxillary and mandibular incisors and canines is 3 to 5 months post partum to about the seventh year of the child's life. The maxillary lateral incisors are an exception because they begin to calcify at 10 to 12 months post partum
- Teeth with tetracycline pigmentation occasionally show evidence of enamel hypoplasia. This is true for both the primary and the permanent teeth.

Mucocoele

- Caused due to traumatic severance or obstruction of salivary duct causing the pooling of mucus in the tissue



- Seen more commonly on the lips
- Appears as raised circumscribed vesicle, several millimeters to a centimeter or more in diameter (Fig. 24.18)
- They are cyst like lesion. When present in the floor of the mouth it is termed as ranula
- Treatment includes excision along with the involved minor salivary gland.



Fig. 24.18: Mucocoele on the lower lip

Ranula

- It is a form of mucocoele occurring specifically in the floor of the mouth in association with the ducts of the submandibular or sublingual salivary glands
- It is painless and slowly enlarging
- Incision is the treatment of choice as the lesion is deep seated

Recurrent Aphthous Stomatitis

- It can be triggered due to any stress, gastrointestinal disturbance, nutritional deficiency, hormonal imbalance, infection, allergy, etc.
- Of the 3 types of aphthous, minor apthae are common, others being aphthous major and herpetiform.
- Prodromal phase of paraesthesia at the site of ulceration is observed. The ulcers appear in crops of two or three and are less than 10 mm in diameter
- Ulcers are painful and are discrete or confluent.
- Persists for about 12 days and heals with no scar formation
- Treatment is symptomatic. Chlorhexidine or nystatin or tetracycline can be prescribed if they are infected.

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Chapter 25



Infection Control

1. Introduction
2. Routes of Transmission of Infection
3. The American Dental Association (ADA) and Occupational Safety Health Act (OSHA) Guidelines for All Dental Office Staff
4. Barrier Precautions
5. Hand Washing and Care of Hands
6. Use and Care of Sharp Instruments and Needles
7. Sterilization or Disinfection of Instruments
8. Cleaning and Disinfection of Dental Unit and Environmental Surfaces
9. Disinfection and the Dental Laboratory
10. Care of Handpieces
11. Single-Use Disposable Instruments
12. Disposal of Health Care Waste Materials
 - Incineration
 - Chemical disinfection
 - Wet thermal treatment
 - Microwave irradiation
 - Encapsulation
 - Safe burying
 - Inertization



INTRODUCTION

The dental environment is associated with a significant risk of exposure to various microorganisms. These infectious agents may be present in blood or saliva and form the source of spread of infection.

ROUTES OF TRANSMISSION OF INFECTION

Infections may be transmitted in the dental operatory through several routes such as:

1. Direct contact with blood, oral fluids, or other secretions.
2. Indirect contact with contaminated instruments, operatory equipment, or environmental surfaces.
3. Contact with airborne contaminants present in either droplet spatter or aerosols of oral and respiratory fluids.

THE AMERICAN DENTAL ASSOCIATION (ADA) AND OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA) GUIDELINES FOR ALL DENTAL OFFICE STAFF

1. Provide Hepatitis B immunization to employees without charge within 10 days of employment.
2. Require that universal precautions be observed to prevent contact with blood and other potentially infectious material. Saliva is considered to be a blood-contaminated body fluid in relation to dental treatments.
3. Implement engineering controls to reduce production of contaminated spatter, mists and aerosols.
4. Implement work practice control precautions to minimize splashing, spatter or contact of bare hands with contaminated surfaces.
5. Provide facilities and instructions for washing hands after removing gloves and for washing skin immediately or as soon as feasible, after contact with blood or potentially infectious materials.
6. Prescribe safe handling of needles and other sharp items.
7. Prescribe disposable or single-use needles. Wires, carpules and sharp items should be disposed as close to the place of use as possible, as soon as

feasible, in hard walled, leak proof containers that are closable. Containers must be red or bear a biohazard label. Extracted teeth must be discarded in the same containers.

8. Contaminated reusable sharp instruments must not be stored or processed in a manner that requires employees to reach hands into containers to retrieve them.
9. Prohibit eating, drinking, handling contact lenses etc. in contaminated environments. Ban storage of food and drinks in refrigerators or other spaces where blood or infectious materials are stored.
10. Place blood and contaminated specimen to be shipped, transported or stored in suitable closed containers that prevent leakage.
11. At no cost to employees, provide them with necessary personal protective equipment (PPE) and clear directions for use of appropriate universal barrier protection in treating all patients (PPE includes gloves, gowns, etc.).
12. Ensure that employees correctly use and discard PPE or properly prepare it for reuse.
13. As soon as feasible after treatments attend to housekeeping requirements including floors, sinks etc that are subject to contamination.
14. Provide a written schedule for cleaning.
15. Contaminated equipment that requires service must first be decontaminated or a biohazard label must be used to indicate contaminated parts.
16. Place reusable contaminated sharp instruments into a basket in a hard-walled container for transportation to the clean-up area. Personnel must not reach hands into containers of contaminated sharps.
17. Provide laundering of protective garments used for universal precautions at no cost to employees.

BARRIER PRECAUTIONS

- During dental procedures, dental health-care workers must wear correct sized gloves when they put their hands into any patient's mouth, and change these gloves between patients (Fig. 25.1). They should also wear gloves when they touch instruments, equipment, or surfaces that may be contaminated with blood or saliva.

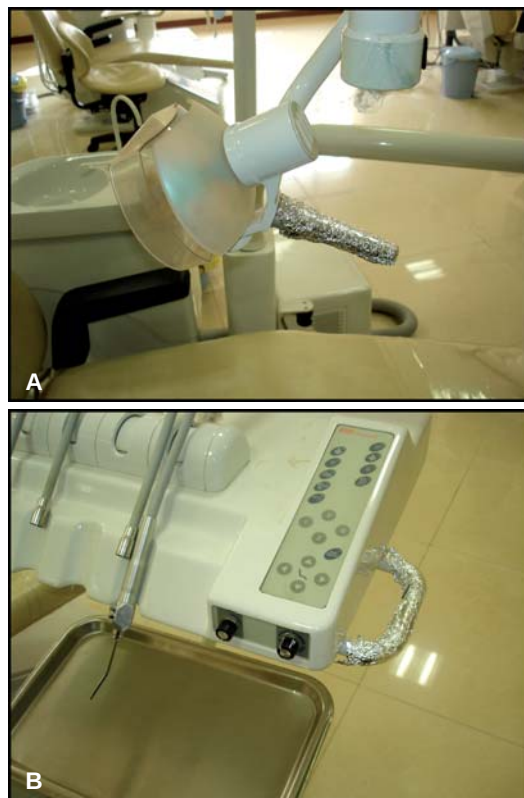


Figs 25.1A and B: A: Loose fit gloves should not be used. B: Gloves should be comfortable when worn with good fit

- Hands must be washed and regloved before performing procedures on another patient. Repeated use of a single pair of gloves or washing of gloves between patients is not recommended, since such practice is likely to produce defects in the glove material, which will diminish its value as an effective barrier.
- Surgical masks and protective eyewear or chin-length plastic face shields must be worn when splashing or spattering of blood, saliva, or oral secretions is likely, as is common during dental procedures.
- Reusable or disposable gowns, laboratory coats, or uniforms must be worn when clothing is likely to be soiled with blood, saliva, or oral secretions. If reusable gowns are worn, they should be washed, using a normal laundry cycle. Gowns should be changed at least daily or when visibly soiled with blood.
- Disposable waterproof coverings such as impervious-backed paper, aluminum foil, or clear plastic wrap may be used to wrap hard-to-clean surfaces such as light handles or x-ray unit heads, etc (Fig. 25.2). These surfaces may be contaminated by blood or saliva and are difficult or impossible to clean and disinfect. To

replace the covering between patients, the coverings should be removed with gloved hands and discarded. Then, after removing the soiled gloves, the coverings can be replaced with clean material.

- Patients case sheets, pen, desk top etc should not be touched with gloved hands (Fig. 25.3). Gloves should be removed before handling unsterile material. Hands should be rewashed before regloving the hands.



Figs 25.2A and B: Areas likely to be touched regularly during treatment such as A. Light handle or B. Tray handle should be wrapped with aluminum foil



Fig. 25.3: Care should be taken not to touch the case sheet, pen, desk or any other areas wearing gloves



HAND WASHING AND CARE OF HANDS

The hands must be washed before and after treating each patient (i.e., before glove placement and after glove removal) and after barehanded touching of inanimate objects likely to be contaminated by blood, saliva, or respiratory secretions. All the jewelry in the hand including watches should be removed (Fig. 25.4). The hands should be scrubbed using liquid soap and washed under tap water. The hands are then dried completely. Hands should be washed after removal of gloves because gloves may become perforated during use and may become contaminated through contact with patient material. Soap and water will remove transient microorganisms acquired directly or indirectly from patient contact. Therefore, for many routine dental procedures, such as examinations and nonsurgical techniques, hand washing with plain soap is adequate. For surgical procedures, an antimicrobial surgical handscrub should be used.



Figs 25.4A and B: Hand wash. A: All jewelry including watch should be removed first. B: Hands should be washed with soap and water and then dried before wearing the gloves

When gloves are torn, cut, or punctured, they should be removed as soon as patient safety permits. Then the hands should be thoroughly washed and regloved to complete the dental procedure. Operators who have exudative lesions or weeping dermatitis, particularly on the hands, should refrain from all direct patient care and from handling dental patient-care equipment until the condition resolves.

USE AND CARE OF SHARP INSTRUMENTS AND NEEDLES

- Sharp items (e.g. needles, scalpel blades, wires) contaminated with patient blood and saliva should be considered as potentially infective and handled with care to prevent injuries.
- Used needles should not be manipulated utilizing both hands, or any other technique that involves directing the point of a needle toward any part of the body. Either a one-handed "scoop" technique (Fig. 25.5) or a mechanical device designed for holding the needle sheath should be employed.
- Used disposable syringes and needles, scalpel blades, and other sharp items should be placed in appropriate puncture-resistant containers located as close as is practical to the area in which the items were used.
- Bending or breaking of needles before disposal requires unnecessary manipulation and thus is not recommended.
- Before attempting to remove needles from nondisposable aspirating syringes, one should recap them to prevent injuries. For procedures involving multiple injections with a single needle, the unsheathed needle should be placed in a location where it will not become contaminated or contribute to unintentional needlesticks between injections.

STERILIZATION OR DISINFECTION OF INSTRUMENTS

As with other medical and surgical instruments, dental instruments are classified into three categories, such as critical, semicritical, or noncritical, depending on their risk of transmitting infection and the need to sterilize them between uses.



Figs 25.5A and B: Safety measures to be taken while handling the needle. A: Wrong and unsafe method to recap the needle as there is high chance of getting pricked. B: The correct method of placing the syringe back into the cap using 'One Hand Scoop technique'

Each dental practice should classify all instruments as follows:

- **Critical:** Surgical and other instruments used to penetrate soft tissue or bone is classified as critical and should be sterilized after each use. These devices include forceps, scalpels, bone chisels, scalers and burs.
- **Semi critical:** Instruments such as mirrors and amalgam condensers that do not penetrate soft tissues or bone but contact oral tissues are classified as semicritical. These devices should be sterilized after each use. If, however, sterilization is not feasible because the instrument will be damaged by heat, the instrument should receive, at a minimum, high-level disinfection.

- **Non critical:** Instruments or medical devices such as external components of X-ray heads that come into contact only with intact skin are classified as noncritical. Because these noncritical surfaces have a relatively low risk of transmitting infection, they may be reprocessed between patients with intermediate-level or low-level disinfection or detergent and water washing, depending on the nature of the surface and the degree and nature of the contamination.

Pre-sterilization Cleaning

1. Before sterilization or high-level disinfection, instruments should be cleaned thoroughly to remove debris.
2. Persons involved in cleaning and reprocessing instruments should wear heavy-duty (reusable utility) gloves (Fig. 25.6) to lessen the risk of hand injuries.
3. Placing instruments into a container of water or disinfectant/detergent as soon as possible after use will prevent drying of patient material and make cleaning easier and more efficient.
4. Cleaning may be accomplished by thorough scrubbing with soap and water or a detergent solution, or with a mechanical device (e.g. an ultrasonic cleaner). The use of covered ultrasonic cleaners, when possible, is recommended to increase efficiency of cleaning and to reduce handling of sharp instruments.



Fig. 25.6: Utility gloves should be worn while cleaning and washing the instruments



Sterilization Methods

All critical and semi critical dental instruments that are heat stable should be autoclaved. Dry heat, or chemical vapor can also be used following the instructions of the manufacturers of the instruments and the sterilizers. Critical and semi critical instruments that will not be used immediately should be packaged before sterilization.

The three most commonly used methods of sterilization in dentistry are:

- The steam autoclave
- The unsaturated chemical vapor sterilizer (chemiclave)
- Dry heat ovens

Other methods are:

- a. Exposure to ethylene oxide gas
- b. Boiling water
- c. Ionizing radiation

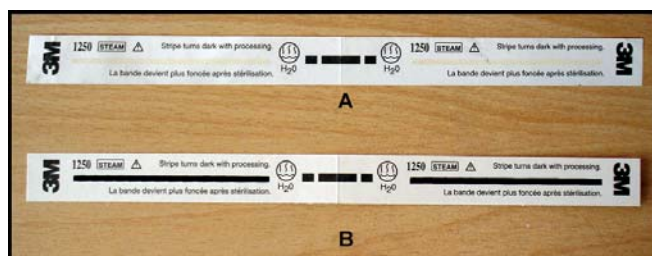
Autoclave: (Steam Under Pressure)

It is an efficient, reliable and rapid method of sterilization except for oils, greases and powders. All living organisms are rapidly destroyed at 121°C temperature and 15 lbs. pressure for 15 minutes. The major problems are excess moisture, air entrapment and severe wetting.

Materials to be sterilized should be wrapped in paper, muslin or steam permeable plastic. To check the efficiency of sterilization, colored stripped (Fig. 25.7) or spore containing carpules (Fig. 25.8) with known numbers of bacillus stearotherophilus are available that should be placed in the deepest layer of the sterilizer load. After sterilization, the strips are observed for any color change. Change in the color to dark brown or black (as per the manufacturer) indicates adequate sterilization. The spore containing carpules are incubated and the presence of growth is checked. Absence of growth proves sterilization. The strips can be placed with every load of instruments and spore carpules can be placed once in a week or once in a month.

Unsaturated Chemical Vapor Sterilizer

This sterilizer uses a special chemical solution containing formaldehyde and alcohol. The major advantage is the greatly reduced corrosion of metal items. Closed



Figs 25.7A and B: Colored strips used for detecting the efficiency of sterilization. A. Before the sterilization. B. After the sterilization, note the change in the color to black



Figs 25.8A and B: Spore containing carpules. A: Fresh carpules; B: Used carpules which will be tested for biologic growth

containers cannot be used, as the chemical vapors must reach the surface of the items being processed. Specified wrapping material should be used.

Dry Heat Sterilizer

These sterilizers use hot air to kill microorganisms and do not cause corrosion. The standard dry heat-sterilizing oven operates at an air temperature of about 320°F for exposure times of 60 to 120 minutes. Closed containers can be used.

A second type of dry heat sterilizer (rapid heat transfer) utilizes a controlled internal air flow system. The instruments warm faster as the 375°F air is rapidly circulated within the chamber. Sterilization time is 6



minutes for unwrapped instruments and 12 minutes for wrapped instruments.

Chemical Sterilization of Instruments

"Sterilant/disinfectant" chemicals are used to attain high-level disinfection of heat-sensitive semi critical medical and dental instruments. The product manufacturers' directions regarding appropriate concentration and exposure time should be followed closely. Liquid chemical agents that are less potent than the "sterilant/disinfectant" category are not appropriate for reprocessing critical or semi critical dental instruments.

Post-sterilization Procedures

Post sterilization procedures involve drying, cooling, storage and distribution. Careful handling, storage and distribution of the sterilized instrument packs or trays reduce the chances for recontamination until the instruments are re used.

If instruments are to be stored after sterilization, they should be wrapped or bagged before sterilizing, using a suitable wrap material such as muslin, clear pouches or paper as recommended by the manufacturer of the sterilizer. The wrap or bag should be sealed with appropriate tape. Pins, staples or paper clips should not be used, as these make holes in the wrap that permit entry of microorganisms. Instruments that are to be used should be kept in a sterilized tray with a lid (Fig. 25.9).



Fig. 25.9: Instruments should be kept closed ready to be used

CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

After treatment of each patient and at the completion of daily work activities, countertops and dental unit

surfaces that may have become contaminated with patient material should be cleaned with disposable toweling, using an appropriate cleaning agent and water as necessary. Surfaces then should be disinfected with a suitable chemical germicide.

These disinfectants include phenolics, iodophors, and chlorine-containing compounds, quaternary ammonium compounds and fresh solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective intermediate-level germicide

DISINFECTION AND THE DENTAL LABORATORY

Laboratory materials and other items that have been used in the mouth (e.g. impressions, bite registrations, fixed and removable prostheses, orthodontic appliances) should be cleaned and disinfected before being manipulated in the laboratory. These items also should be cleaned and disinfected after being manipulated in the dental laboratory and before placement in the patient's mouth.

CARE OF HANDPIECES

Routine between-patient use of a heating process capable of sterilization (i.e. autoclaving, dry heat, or heat/chemical vapor) is recommended for all high-speed dental hand pieces, low-speed hand piece components used intraorally. Manufacturers' instructions for cleaning, lubrication, and sterilization procedures should be followed closely to ensure both the effectiveness of the sterilization process and the longevity of these instruments.

SINGLE-USE DISPOSABLE INSTRUMENTS

Single-use disposable instruments (e.g. prophylaxis cups and brushes; tips for high-speed air evacuators, saliva ejectors, and air/water syringes) should be used for one patient only and discarded appropriately. These items are neither designed nor intended to be cleaned, disinfected, or sterilized for reuse.

DISPOSAL AND TREATMENT OF HEALTH CARE WASTE MATERIALS

The wastes are collected separately in color coded bags (containing the symbol of biohazard Fig. 25.10)



depending on the method of treatment to be used for disposal. Segregation is done as follows:



BIOHAZARD

Fig. 25.10: Symbol that denotes 'Biohazard'

Red bags: Wastes that are contaminated and cannot be incinerated. It includes gloves, suction tips and similar items

Yellow bags: Wastes that are contaminated but can be incinerated. It includes material like cotton and gauze.

Blue plastic container: Wastes such as blade or needles.

Black bags: Wastes that are uncontaminated such as empty bottles, paper covers etc

Treatment and disposal technologies for health-care waste are:

1. Incineration
 - Pyrolytic
 - Single chamber
 - Rotary kiln
2. Chemical disinfection
3. Wet thermal treatment
4. Microwave irradiation
5. Encapsulation
6. Safe burying
7. Inertization.

Incinerators

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic,

incombustible matter and results in a very significant reduction of waste volume and weight.

This process is usually used to treat wastes that cannot be recycled, reused or disposed off in a landfill site.

Types of Incinerators

- Double—chamber pyrolytic incinerators
- Single—chamber furnaces with static grate
- Rotary kilns.

Pyrolytic Incinerators

This is the most reliable and commonly used process for health-care waste. They are also called controlled air incineration or double - chamber incineration.

The pyrolytic incinerators comprises:

- A pyrolytic chamber
- A post-combustion chamber.

In the pyrolytic chamber, the waste is thermally decomposed through an oxygen deficient medium temperature combustion process [800 to 900°C] producing solid ashes and gases. The pyrolytic chamber includes a fuel burner, used to start the process. The waste is loaded in suitable waste bags or containers. The gases produced in this way are burned at high temperature [90 to 1200°C] by a fuel burner in the post-combustion chamber, using an excess of air to minimize smoke and odors.

Drawbacks:

- Relatively expensive equipment
- Expensive to operate and maintain
- Well-trained personnel are required.

Incinerators must be located at a minimum distance of 500 meters from any human settlement.

Single-chamber Incinerator

This can be used for health-care waste if a pyrolytic incinerator cannot be afforded. This type of incinerator treats waste in batches. Loading and de-ashing operations are performed manually. The combustion is initiated by addition of fuel and should then continue unaided.

Drawbacks

- Chemical and pharmaceutical residues will persist if temperatures do not exceed 200°C.



- The process will cause emission of black smoke, fly ash and potentially toxic gases
- Exhaust gas cleaning is not practicable - can cause air pollution

Rotary Kiln

A rotary Kiln comprises of a rotating oven and a post-combustion chamber. The kiln rotates 2 to 5 times per minute and is charged with waste at the top. Ashes are evacuated at the bottom end of the kiln. The gases produced in the kiln are heated to high temperatures to burn off gaseous organic compounds in the post-combustion chamber and typically have a residence time of 2 seconds.

Rotary kilns can be used for

- Infectious waste [including sharps] and pathological waste
- All chemical and pharmaceutical wastes including cytotoxic waste.

Disadvantages of rotary kilns:

- Well trained personnel are required
- Equipment and operation costs are high
- Energy consumption is high
- Highly corrosive waste and by-products damage the refractory lining of the kiln

Chemical Disinfection

In this method, chemicals are added to waste to kill or inactivate the pathogens. This method is most suitable for treating liquid waste such as blood, urine, stools or hospital sewage.

The effectiveness of disinfection is estimated from the survival rates of indicator organisms in standard microbiological tests.

Types of Chemical Disinfectants

1. *Formaldehyde*: It has an inactivating effect against all microorganisms including bacteria, viruses and bacterial spores [contact time: 45 minutes]
2. *Ethylene oxide*: It inactivates all microorganisms including bacteria, viruses and spores. It can also disinfect solid wastes at temperatures of 37 to 55°C at 60 to 80% humidity for 4 to 12 hours.

The use of ethylene oxide is not recommended because of significant health hazards.

3. *Glutaraldehyde*: It is active against both bacteria and parasite eggs. It should be used as 2% aqueous solution with acetate buffer.

Contact time: 5 minutes for disinfection of medical equipment and 10 hours to kill spores.

Glutaraldehyde waste should never be discharged in sewers. It may be neutralized through careful addition of ammonia or sodium bisulfite. It may also be incinerated, after mixing with a flammable solvent.

4. *Sodium hypochlorite*: It is active against most bacteria, viruses and spores. Not effective for disinfection of liquids with high organic content such as blood or stools.
5. *Chlorine dioxide*: It is active against most bacteria, viruses and spores

Wet Thermal Treatment

Wet thermal treatment or steam disinfection is based on exposure of shredded infectious waste to high-temperature, high-pressure steam. It inactivates most types of microorganisms.

This process requires that waste be shredded before treatment to increase disinfection efficiency. The process is inappropriate for the treatment of anatomical waste and animal carcasses.

Disadvantages

- a. The shredder is liable to mechanical failure and breakdown
- b. The efficiency of disinfection is very sensitive to the operational conditions

Advantages

- a. Relatively low investment and operating costs
- b. The low environmental impact

Microwave Irradiation

Most microorganisms are destroyed by the action of microwaves of a frequency of about 2450 MHz. Although this process is becoming increasingly popular, relatively high costs coupled with potential operation



and maintenance problems mean that it is not yet recommended for use in developing countries.

Encapsulation

This procedure involves filling containers, made of high density polyethylene or metal drums, with waste. These containers are then filled up with a medium of immobilizing material such as plastic foam, cement mortar or clay. After the medium has dried, the containers are sealed and disposed of in landfill sites. It is a simple, low-cost and safe method but not recommended for non-sharp infectious waste.

Safe Burying

Safe burial of waste may be used when this is the only viable option available especially in establishments which use minimal programs for health care waste management.

Certain basic rules that should be followed are:

- a. Access to the disposal site should be restricted to authorized personnel only.
- b. The burial site should be lined with a material of low permeability like clay.
- c. Only hazardous health-care waste should be buried, so as to conserve space.
- d. Large quantities of chemical waste should not be buried at one time to avoid environmental pollution.
- e. The burial site should be covered with a layer of earth to prevent health hazards.

Inertization

This process involves mixing waste with cement and other substances before disposal in order to minimize the risk of toxic substances contained in the waste migrating into surface water or ground water. It is especially suitable for pharmaceuticals and for incineration ashes with a high metal content. This is a relatively inexpensive method of waste disposal but it is not applicable to infectious waste.

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Chapter 26



Genetics in Pediatric Practice

1. Introduction
2. Commonly Used Terms
3. Classification of Chromosomal Aberrations
4. Commonly Seen Genetic Disorders
5. Down's Syndrome
6. Trisomy 18 (Edward's Syndrome)
7. Cri Du Chat (Cat Cry Syndrome)
8. Turner's Syndrome
9. Klinefelter's Syndrome
10. Genetics and Dental Caries
11. Genetics and Periodontal Disease
12. Genetics and Malocclusion
13. Genetic Counseling



INTRODUCTION

Genetic abnormalities comprises of disorders due to defect in the genetic system comprising of the genes and the chromosomes. Gene is the genetic material, DNA, that controls the production of a single protein (or polypeptide chain). Genes are grouped into units called chromosomes. Humans have 46 chromosomes that contain an estimated 100,000 genes, including numerous duplicates. Each chromosome has a paired mate that is referred to as the homolog. Genes on homologs control the same genetic traits and, except for genes on the X and Y chromosomes, there are at least two genes that control each inherited trait. Thus the human chromosome complement consists of 23 pairs of chromosomes. Twenty-two of these pairs are the autosomes; the remaining pair, the X and the Y chromosome, are the sex chromosomes.

SOME OF THE COMMON TERMS USED TO DESCRIBE GENETIC ABNORMALITIES

Autosomal dominant disorders: They arise due to the defects in at least one gene out of a pair of genes on autosomes and are vertically transmitted in very generation. Each child of an affected parent is at 50% risk of inheriting the abnormal gene.

Autosomal recessive disorders: These occur when both the genes on an autosomes are affected. Since two abnormal genes are required for obtaining a given clinical phenotype their incidence is low compared to autosomal dominant disorders.

X-linked disorders: These are disorders that arise due to the defect in the gene(s) located in X-chromosome.

Deletion: Loss of part of chromosome, e.g. cri-du-chat syndrome.

Translocation: A portion of chromosome attached to another, e.g. translocation carrier.

Inversion: A portion of chromosome upside down.

Duplication: A chromosome is larger than normal, the extra segment being identical to a segment of the normal chromosome.

CLASSIFICATION OF CHROMOSOMAL ABERRATION

Chromosomal aberrations can be classified as:

1. According to number of cells involved:

- i. Involving chromosome sets.
 - Monoploidy (Haploid, 23X)
 - *Euploid:* A complete second set of chromosome, the total number being 92 (46+46)
 - *Polyloid:* Three triploid or four tetraploid complete sets of chromosome. This is incompatible with human life.
- ii. Involving individual chromosome (Aneuploidy): Any extranumber of chromosomes that do not represent an exact multiple of total chromosome complement.
 - a. Involving autosomes.

Monosomy—A missing chromosome pair.

Trisomy—Down syndrome (45+ XX or 45 + XY)
 - b. Involving sex chromosomes for example,
 - Turner's syndrome.
 - Klinefelter's syndrome.
 - Superfemale.

2. According to alteration in structure of chromosome:

- a. Deletion—loss of part of chromosome, e.g. cri-du-chat syndrome.
- b. Translocation—a portion of chromosome attached to another, e.g. translocation carrier.
- c. Inversion—a portion of chromosome upside down.
- d. Duplication—a chromosome is larger than normal, the extra-segment being identical to a segment of the normal chromosome.

3. According to type of chromosome abnormality:

- a. Gross chromosomal aberrations in which there is either a structural or numerical abnormality of chromosome.
- b. Single gene abnormalities which are transmitted in an autosomal dominant, autosomal recessive or X-linked pattern.
- c. Polygenic disorders in which environmental interaction may play a significant role.



Down Syndrome (Mongolism)

It is one of the most common recognizable malformation syndromes and has an incidence of approximately one in 600 new borns.

Types of Down Syndrome

There are 3 main types of Down syndrome:

1. *Trisomy 21*: Vast majority of children (95%) with Down syndrome have an extra 21 chromosome. Instead of normal 46 chromosome, the individual has 47 chromosome (45+XX or 45+XY). This condition is called trisomy 21.
2. *Translocation*: Less common is called translocation where the extra 21 chromosome material is attached or translocated on to another chromosome, usually on 14, 22 or 21. In at least 1/3 of the cases a parent may be a carrier of the translocation.
3. *Mosaicism*: It is the least occurring types. In this some cells have 47 chromosome and others have 46 chromosome.

Etiology

Although many theories have been developed, it is believed to be due to:

- Hormonal abnormalities
- X-Rays
- Viral infection
- Immunologic problems
- Genetic predisposition
- Advancing maternal age

Clinical Features

Head: Microcephaly with prominence of fore head, shortening of anteroposterior diameter and flattening of occiput.

Face: Round flat face with characteristic flat nasal bridge, epicanthal folds and upward - slanting palpebral fissures.

Eyes: Hypoplasia of iris stroma and Brushfield spots.

Mouth:

- Underdevelopment of maxilla contributing to open mouth

- Normal appearing protruded tongue
- Palate is of normal height but short and narrow
- Delayed and abnormal sequence of eruption of teeth. First primary teeth may not appear until 2 year of age, and dentition may not be complete by 4 to 5 years of age.
- Defective or absent of upper incisor
- Anomalies of tooth shape.
- Early shedding of deciduous dentition.
- High incidence of rapid destructive periodontal disease
- Bruxism
- Malocclusion
- Poor oral hygiene.
- Dental caries susceptibility is usually low in those with Down syndrome. This is due to increased pH of saliva, delayed eruption and early shedding of primary teeth.
- Congenital absence of permanent teeth is common.

Limbs:

- Broad and shortened hands, feet and digits
- Simian crease (transverse palmar crease)
- Decreased muscle tone and loose ligaments.
- Clinodactyly (permanent deviation of one or more finger)
- Wide space between the 1st and 2nd toes are present in majority of patient.

Nervous System:

- Level of intelligence in these children (25-50 IQ) ranges from mild to severe retardation
- Generalized muscular hypotonia which becomes less pronounced with increasing age
- Hearing defects.
- Congenital heart disease.
- Intestinal abnormalities, e.g. blockage of esophagus, duodenum
- Increased incidence of eye problems such as cataracts, strabismus, near sightedness, far sightedness, etc.
- Thyroid dysfunctions — hypothyroidism.
- Skeletal problems such as kneecap subluxation, hip dislocation, atlantoaxial instability and severe neck problems



- Leukemia, immunologic problems, Alzheimer's disease, seizure disorders, sleep apnea and skin disorders.

Trisomy 18 (Edward's Syndrome)

- Children with this disorder are more seriously affected than in Down syndrome
- Usually they have short life span of few months
- It is associated with an extra 18 autosome (45 + XX).

Clinical Features

- Marked retardation in physical and mental growth and development
- Low birth weight
- Hypertonicity of muscles
- Epicanthal folds, small mouth and micrognathia
- Low set ears, prominent occiput and small eyes
- Flexion and overlapping of fingers
- Congenital heart disease.

Trisomy 13 (Patau Syndrome)

- This disorder is characterized by multiple abnormalities in various organs. 70% live born infants die within 7 months
- Characteristic clinical findings include bilateral cleft lip and palate, microphthalmia or anophthalmia (small or no eyes) superficial hemangioma of forehead or nape of neck, growth retardation, severe mental retardation, polydactyly of hand and feet, clenching of fist with the thumb under the fingers, several anomalies of external genitals and defects of the brain.

Cri-Du-Chat (Cat Cry Syndrome)

- This syndrome is characterized by a deletion on the short arm of chromosome 5. Newborn with a chromosome 5 deletion exhibit cat like cry at birth due to abnormality of larynx and are mentally retarded
- Physical changes include hypotonia, microcephaly, downward slanting of palpebral fissures,

hypertelorism and epicanthic folds, cleft lip and cleft palate.

Turner's Syndrome (Gonadal Dysgenesis)

It results from complete or partial monosomy of X chromosome and is characterized primarily by hypogonadism in phenotypic female.

Clinical Features

- These women have short stature
- Webbing of neck
- Edema of hand and feet
- Exhibit a low hairline at the nape of neck
- Body hair is sparse
- The chest is broad with wide space nipples
- The aorta is frequently abnormal
- Idiopathic hypertension
- Hypoplastic 4th metacarpal
- Poor development of secondary sexual characteristics and streak gonads
- High arched palate and hypoplastic mandible
- Hearing loss.

Klinefelter's Syndrome

Defined as male hypogonadism that occurs when there are two or more X chromosomes.

Clinical Features

- Male phenotype and condition cannot be detected until after puberty
- These patient are taller than normal
- Have wide hips
- Gynecomastia
- Intelligence levels are lower than normal
- Small testis
- Absence of spermatogenesis of seminiferous tubules

GENETICS AND DENTAL CARIES

It is often seen that children living in similar environmental conditions have different susceptibility for caries. This difference can be attributed to genetic



difference and this makes a person more susceptible than the other. Therefore, genetic influences may modify the overt expression of the disease in an individual.

GENETICS AND PERIODONTAL DISEASE

It is observed that about 38 to 82% of the periodontal disease is attributable to genetic factors. Several forms of early-onset periodontitis (e.g. localized prepubertal periodontitis, localized and generalized aggressive periodontitis) are found to be influenced by other genetic factors. A number of other conditions that can predispose to periodontal disease, such as leukocyte adhesion deficiencies, Chediak-Higashi syndrome, cyclic neutropenia, and Papillon-Lefevre syndrome have been associated with genetic influence.

GENETICS AND MALOCCLUSION

Factors necessary to attain and maintain normal occlusion such as skeletomuscular balance, the size of the maxilla, the size of the mandible, the arch form, anatomy of teeth and the presence or absence of teeth have genetic influence. Genetic influences on each of these traits are rarely due to a single gene and are often polygenic with potential for environmental influence.

It is thus not possible to make accurate predictions about the development of occlusion in a child by simply studying the frequency of its occurrence in parents. Although family patterns of resemblance are frequently obvious, predictions must be made cautiously because of the genetic and environmental variables that are unknown and difficult to evaluate.

GENETIC COUNSELING

Genetic disorders occur among nearly 30% of admissions to pediatric hospitals, and mortality rate is between 40 to 50%. Genetic diseases are almost always serious, are not curable and relatively few are amenable to satisfactory modes of treatment. Thus in current situation the prevention of this group of diseases remains of paramount importance. The most effective means

of preventing genetic diseases remains the provision of genetic counseling for individuals at risk of having a child with a serious genetic disorder.

Definition

The American Society of Human Genetics in 1975 has defined genetic counseling as “a process of communication, the intent of which is to provide individuals and families having a genetic disease or at risk of such a disease with information about their condition and to provide information that would allow couples at risk to make informed reproductive decisions.”

Indications for genetic counseling

1. Know or suspected hereditary disease in a patient or family
2. Birth defects
3. Unexplained mental retardation
4. Advanced maternal age
5. Exposure to a teratogen
6. Consanguinity

The Information Conveyed During Genetic Counseling

1. The magnitude of the risk
2. The burden of the disease on the patient and family
3. Possibility of modification of either the burden or the risk

The psychological needs and issues associated with the genetic counseling process are many and complicated. There is need to cope and come to terms with emotionally traumatic information, and they need to make decisions in future reproductive plans and may also need to make fundamental alternations to their feeling about themselves and about interpersonal relationship.

Process Involved in Genetic Counseling

1. The first step in genetic counseling is to ascertain what question the counselee (the individual seeking



counseling) is really asking. Since it involves communication, one must assess the receptivity, emotional and intellectual, of the individuals seeking counseling.

2. Couples should be counseled together in a quiet room.
3. The mode, in which this type of information is explained to counselees, is of utmost importance and also greatly influences the interpretation of the facts. Discussion of the options open to a couple makes the counseling process more comprehensive and relevant.
4. The information must be conveyed in a language that can be understood by the counselee. It should be believed that openness and honesty are the best way to present such information. The information communicated is heavy with emotional content and often contains medical or scientific information that is difficult for an individual to comprehend.
5. Genetic counseling must not be directive, i.e. the counselee should not be directed to whether to have children or not. Reproductive decisions are highly personal ones and should be left to individual couples rather than being made by their physicians and counselors.
6. The verbal counseling should be followed up by a letter, which enables them to read and reread the counseling and to share it with physicians, family members or other supportive individuals.

The process of genetic counseling can be divided into 4 consecutive phases:

- Initial phase: information is gathered and diagnosis is made.
- Facts about disease, genetic implication and possible options are imparted to and discussed with the counselee.
- Counselee evaluates, assimilates and learns to cope with the given information
- Decisions are made.

Psychological Aspects of Counseling

The responsibility of a genetic counselor does not end when he has made an accurate diagnosis. He must, in

transmitting his information to the individual concerned, take into account the psychological effect of unfavorable prospects. It is not sufficient to tell the truth, but it is necessary to tell it humanely. Lack of motivation, overt anxiety and even hostility can seriously disrupt the counseling relationships. The factor most commonly found by counselors to cause difficulties in effective communication is the educational background of their client and in particular the client's knowledge of biology. The environment in which the counseling takes place can also greatly influence the process.

For a counselee to achieve the goal of psychological homeostasis and be in a position to make the important decisions that are necessary, they must have experienced the 4 phases of coping process known to follow the exposure to stressful situation.

These phases are:

- 1st phase : Shock
- 2nd phase : Denial, anger
- 3rd phase : Guilt, anxiety
- 4th phase : Depression

Awareness regarding that these phases are natural course of events and their identification can help the counselor plan his approach more successfully.

Apart from the obvious problem of finding effective treatments for genetic disorders, there is an important need to ensure that genetic advice is made as widely available as possible. There is evidence that there are many people in the population who are unaware of this. Increasing knowledge of genetics and appreciation of the risks by physicians will help to reduce this problem. There seem to be very good reasons, both ethical as well as financial, for encouraging efforts to develop and extend the preventive approach to genetic disease.

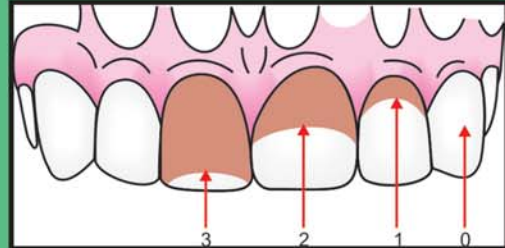
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Chapter 27



Survey Procedures and Indices

1. Introduction
2. Definition
3. Types of Surveys
 - a. Descriptive survey
 - b. Analytic survey
 - c. Cross-sectional survey
 - d. Longitudinal survey
4. Survey Methods
 - a. Health interview survey
 - b. Health examination survey
 - c. Health records survey
 - d. Questionnaire survey
5. Uses of Surveys
6. Steps in Surveying
 - Establishing the objectives
 - Designing the investigation
 - Selecting the sample
 - Conducting the examinations
 - Analyzing the data
 - Drawing the conclusions
 - Publishing the results.
7. The WHO outline for a Formal Report Writing
8. Oral Health Surveys [Pathfinder Surveys]
 - i. Pilot survey
 - ii. National pathfinder survey
9. Indices Used in Routine Dental Practice
 - i. Definition
 - ii. Criteria for selection of index
 - iii. Oral hygiene Index-simplified (OHI-S index)
 - iv. Plaque index
 - v. Gingival index
 - vi. Caries index



INTRODUCTION

Survey is a non-experimental type of research that attempts to gather information about the status quo for a large number of cases by describing present conditions without directly analyzing their causes.

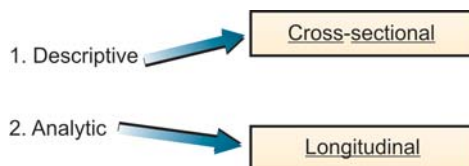
Surveying is far more than collecting and arraying of facts. It is a task through which many key people in a community become aware of the dental needs of the community and what can be done about them. These people are the ones who will subsequently rally popular support for the program. The real focus of any dental health survey involves the measurement of dental disease or morbidity. The teeth and their surrounding structures are so definite, easy to observe and carry with them so much of their previous disease history that the measurement of dental disease is easier than the measurement of many other forms of disease.

DEFINITION

A survey is most easily defined negatively as a "non-experimental investigation".

It is an investigation in which information is systematically collected, but in which there is no active intervention by the investigators. The purpose of most surveys is to collect information that will provide a basis for action, whether immediately or in the long-term run.

TYPES OF SURVEYS



Descriptive Survey

A descriptive survey sets out to describe a situation, e.g. the distribution of a disease in a population in relation to sex and age.

Analytic Survey

An analytic [or explanatory] survey tries to explain the situation, i.e. to study the determinative process. This is done by formulating and testing hypothesis.

The distinction between a descriptive and analytic survey is not always clear and a single survey can combine both purposes, e.g. a broad descriptive survey may be so planned, that it also provides information for the testing of a specific hypothesis.

Surveys whether descriptive, analytic or mixed can be usefully categorized as cross-sectional or longitudinal, depending on the time period covered by the observations.

Cross-sectional Survey

A cross-sectional [instantaneous, simultaneous, prevalence] survey provides information about the situation that exists at a single time.

Longitudinal Survey

A longitudinal [time span] survey provides data about events or changes during a period of time.

SURVEY METHODS

Health surveys can be broadly classified into four types.

1. Health interview survey (face to face survey)
2. Health examination survey
3. Health records survey
4. Questionnaire survey

Health Interview Survey: [Face-to-face survey]

It is an invaluable method of measuring subjective phenomena, such as perceived morbidity, disability and impairment; opinions, beliefs and attitudes and some behavioral characteristics. However, the data obtained like this, may not be reliable, because of the limitation of the interview method. That is why interviews are often combined with health examination surveys.

Health Examination Survey

The information obtained through this method is more valid than health interview survey. Teams consisting of doctors, technicians and interviewers carry out this survey.



Disadvantages

- It is expensive and cannot be carried out on an extensive scale.
- The method also requires consideration-providing treatment to people found suffering from certain diseases.

Health Records Survey

It involves the collection of data from health service records. This is obviously the cheapest method of collecting data.

Disadvantages

- The data obtained is not population-based.
- Reliability is open to question.
- Lack of uniform procedures and standardization in the recording of data.

Questionnaire Survey

It is used for measuring subjective phenomena.

Advantages

- Simpler
- Economical
- Standardization [written instructions reduce biases from differences in administration.
- Anonymity - Privacy encourages candid and honest responses to sensitive questions.

Disadvantages

- A certain level of education and skill is expected from the respondents.
- There is usually a high rate of non-response.

USES OF SURVEYS

1. Monitoring trends in oral health and disease
2. Policy development
3. Program evaluation
4. Assessment of dental needs
5. Providing visibility for dental issues

Monitoring Trends in Oral Health and Disease

When national surveys are repeated periodically under general similar conditions, broad oral health trends over time can be estimated, provided the sampling design so permits, a single survey can show how oral health varies by geographic region, social class or by race or ethnic group. The WHO's pathfinder survey protocol when repeated periodically can assess trends in health and disease and it is assumed that the results are valid enough to support national policy decisions.

Policy Development

Survey data can be used to establish oral health strategies. Scotland has successfully used survey data to develop its oral health policy. A number of American States switched their primary preventive focus from fluoride mouth-rinsing to sealant application after statewide surveys showed most carious lesions to be in pits and fissures.

Program Evaluation

Survey data are often used to evaluate programs though the principle that association does not show cause-and-effect needs to be remembered.

A survey is not a randomized controlled / [clinical] trial and inferences need to be made with caution. The success of particular programs can only be inferred from survey data, though the more localized the survey and the program, then the more plausible is the inference.

Assessment of Dental Needs

Although surveys can be used for assessment of the needs, there is a clear gap between the criteria used in surveys and those applied by dentists for patient care. e.g. criteria for caries in surveys usually are based on cavitations, but dentists generally intervene at an earlier stage in the carious process.

Providing Visibility of Dental Issues

The visibility that oral health acquires through the mere existence of data from a national survey may be the most important of all uses of survey data.



STEPS IN SURVEYING

1. Establishing the objectives
2. Designing the investigation
3. Selecting the sample
4. Conducting the examinations
5. Analyzing the data
6. Drawing the conclusions
7. Publishing the results.

Establishing the Objectives

The investigator must be absolutely clear about the objective of the investigation before considering its design, as the latter is entirely dependent on the former. The objectives can either be stated in the form of a hypothesis which is to be tested, or the objective may be stated by describing what is to be measured. Having determined the objectives, each subsequent stage of the investigation must be carried out in a way that will enable these objectives to be met.

Designing the Investigation

Survey Protocol

It is important to prepare a written protocol for the survey, which should contain:

- A. Main objective and purpose of the survey,
- B. A description of the type of information to be collected and of the methods to be used.
- C. A description of the sampling methods to be used.
- D. Personnel and physical arrangements.
- E. Statistical methods to be used in analyzing the data.
- F. A provisional budget.
- G. A provisional timetable of main activities and responsible staff.

Obtaining approval from authorities: Permission to examine population groups must usually be obtained from a local, regional or national authority. For example, if school populations are to be examined, school authorities and the parents should be approached for obtaining permission. The health authorities should also be notified, since it may be necessary to time the survey to fit in with other health related activities.

Budgeting

A budget for the survey should be prepared which should include all the resources required to carry out the survey.

Scheduling

An orderly schedule should be prepared for data collection, to prevent the waste of valuable time. The schedules should allow for some flexibility so that unexpected delays do not cause major upsets in the survey timetable. Since fatigue contributes significantly to inaccuracy and inconsistency, it is unwise to make the schedule too demanding. It is not advisable to schedule more than 15 children to be examined in an hour.

Emergency Care and Referral

All survey teams should be equipped for and ready to provide emergency care if required. It is also the responsibility of the examiner to ensure that referral to an appropriate care facility is made.

Selecting the Sample

While designing a study, it is usually impossible to examine every individual in the population under investigation. Resources in terms of time, manpower and money may not be available for the collection and analysis of vast amounts of data. For this reason, a sample must be chosen from the population.

Definition of Sample

Sampling is the process or technique of selecting a sample of appropriate characteristics and adequate size.

Advantages of sampling

- i. It reduces the cost of the investigation, the time required and the number of personnel involved.
- ii. It allows thorough investigation of the units of observation.
- iii. A sample can be covered more adequately and in more depth than can a total population.



Requisites for a Reliable Sample

- a. *Efficiency*: The ability of the sample to yield the desired information.
- b. *Representativeness*: A sample should be representative of the parent population, so that the inferences drawn can be generalized to that population with precision.
- c. *Measurability*: The extent to which findings from the sample differ from that of the parent population should be able to be measured.
- d. *Size*: A sample should be large enough to minimize sample variability.
- e. *Coverage*: A sample should provide adequate coverage of the population.
- f. *Feasibility*: The design should be simple enough to be carried out in practice.
- g. *Economy and cost efficiency*: The sample should yield the desired information at a fixed low cost with least sampling error.

Sampling Methods

Random sampling: [simple random sampling]

It is a technique whereby each sampling unit has the same probability of being selected.

Basic procedure involved:

- i. Prepare a sampling frame
- ii. Decide on the size of the sample
- iii. Select the required number of units by:
 - Lottery method
 - Table of random numbers

Systematic sampling: The first unit is chosen at random and then, other units are chosen in a systematic way. For example, every third patient visiting the dentist.

Stratified sampling: The population is first divided into subgroups or strata according to certain common characteristics. Then random or systematic sampling is performed independently in each stratum:

- Stratified random sampling;
- Stratified systematic sampling.

Advantages

1. It eliminates sampling variation with respect to be the properties used in stratifying.

Cluster sampling: Here, a simple random sampling is selected, not of individual subjects, but of groups or clusters of individuals. The sampling units are clusters and the sampling frame is a list of these clusters.

Advantages:

- A. Administratively simple
- B. Less expensive than random sampling.

Disadvantages:

- A. If clusters contain similar persons, the findings cannot be generalized to the parent population.

Other Types of Sampling

Multistage sampling: It is a sub-sampling within groups chosen as cluster samples. The first stage is to select the groups or clusters. Then sub-samples are taken in as many subsequent stages as necessary to obtain the desired sample size. For example, 1st stage: choice of states within countries; 2nd stage: choice of towns within each state; 3rd stage: choice of neighborhoods within each town.

Multiphase sampling: This is used to take basic data from a large sample and details from a sub-sample.

Sequential sampling: Here, a small sample is tested in order to answer certain questions about the population. If the questions are not answered, the number of subjects or units in the sample is increased gradually until the conclusions may be drawn.

Panels: They are useful for studying trends. A sample is randomly selected and then data are collected from the sample on several occasions. For example, every person is interviewed every 6 months.

Area sampling: It is a type of random sampling in which maps rather than lists are used.

Conducting the Examinations

The three important aspects in the survey of dental disease and conditions are:

- the examination methods and diagnostic aids;
- the diagnostic criteria;
- the indices used for measurement.



The Basic Requirements for an Oral Examination

- A. A chair preferably with a head rest
- B. A source of illumination, which can either be a separate unit, a lamp attached to the head of the examiner or a fiber optic light source
- C. Some methods of cleaning the teeth to remove loose debris where necessary.
- D. A recorder, live or tape, is necessary for receiving the information called by the examiner.
- E. Some workers prefer to have the subject in a reclining position on a couch; the dentist can then remain seated at the head and no bending or chair adjustments are required to compensate for the varying size of the subjects.
- F. The length of time that it takes to examine each subject depends on the extent and detail of the examination and the habits and inclination of the examiner. Extremes of thirty seconds to one and a half hours have been admitted.
- G. The examination should be as automatic as possible to obviate excessive intrusion of subjective thought. Therefore it should be performed quickly. The object of epidemiological surveys is to examine subjects in fairly large numbers. Excessive time spent on each individual necessitates a reduction in the number of individuals seen. The flow of subjects through the examination unit needs careful regulation and should be discussed prior to arrival.
- H. The diagnostic method chosen should be both valid and reliable. The validity of a test is its ability to measure what is intended to measure. For example, all ill individuals should be detected but no healthy subjects should be diagnosed as ill. The validity can be determined by calculating the sensitivity and specificity of the method.

A test is **sensitive** if all cases in which the condition exists are positively diagnosed.

A test is **specific** if a positive diagnosis is made only when the condition is present. [e.g. False positive: where a sound surface has been diagnosed as carious. False negative: where a carious surface has been diagnosed as sound.

The **reliability** of a test is its ability to give the same results if repeated. The reliability or repeatability of a diagnostic method may be measured by carrying out the examination on two occasions and comparing the results. This is sometimes known as test-retest

Classification of Types of Inspection and Examination

The ADA has standardized four main types of examination and inspection.

Type 1: Complete examination, using mouth mirror and explorer, adequate illumination, thorough roentgenographic survey and when indicated, percussion, pulp-vitality tests, trans-illumination, study models and laboratory tests. This method can seldom be used in public health work.

Type 2: Limited examination, using mouth mirror and explorer, adequate illumination, posterior bitewing roentgenograms. This method is of great value where public health programs combine service to individual patients with population survey work and gives superior results for pure survey work where time and money permit.

Type 3: Inspection, using mouth mirror and explorer and adequate illumination. This is the most-used method in public health surveying.

Type 4: Screening, using tongue depressor and available illumination. This method identifies individuals in urgent need of treatment, but is too unreliable for most public health surveying.

Selection of the Examiners

The following precautions should be taken when selecting the examiners.

- a. Keep the number of examiners to a minimum.
- b. Discuss the interpretation of borderline problems carefully in advance, e.g. distinction between non-carious and carious pits or fissures.



- c. Use only one make and design of explorer, making rules for discard as explorers become dull.
- d. Have all members of the team examine a few cases in sequence and then exchange cases until each examiner has examined each patient, to minimize divergences of opinion or observation.
- e. Type and circulate among the examiners any rules or systems which may seem pertinent.
- f. The supervisor should recheck an occasional case throughout the entire survey.
- g. Subtle changes in interpretation should be guarded against.

For maximum efficiency, recorders should be provided.

Sufficient numbers of instruments should be available to avoid the need to interrupt examinations while used-ones are sterilized. [A minimum of 30 sets per examiner]

The organizer of the survey should maintain a log book in which are recorded the location of each day's examinations, the number of persons examined and information about each location.

Analyzing the Data

Once the examination procedures of a survey have been completed, the work of assembling the material and interpreting it begins. In large surveys, where detailed findings are to form the basis of clinical research, transfer to punched cards may prove advisable. In small public health surveys, tally sheets can be set up to produce frequency distributions, that is, numbers of cases showing the different categories of findings. From these frequency distributions, means and standard deviations can be computed.

Drawing the Conclusions and Publishing the Report

The conclusions are specifically related to the investigation that has been carried out and no extrapolation is made to the population as a whole unless the investigation was designed accordingly.

The final step in the survey procedure should be the construction of a report with or without set of recommendations. Clearness and simplicity should be sought.

The WHO outline for a formal written report A:

1. Statement of the purposes of the survey.
2. Material and methods.
 - Description of area and population served.
 - Types of information collected.
 - Methods of collecting data
 - Sampling method
 - Examiner personnel and equipment
 - Statistical analysis and computational procedure
 - Cost analysis
 - Reliability and reproducibility of results.
3. *Results*: They should be tabulated and illustrated appropriately.
4. *Discussion and conclusions*: The investigations, its findings and its conclusions are discussed.
5. Summary.

ORAL HEALTH SURVEYS [PATHFINDER SURVEYS]

Basic oral health surveys are used to collect information about the oral health status and treatment needs of a population and subsequently, to monitor changes in levels and patterns of disease.

There are special factors associated with the most common oral diseases which have enabled a practical, economic survey sampling methodology to be defined, called the "pathfinder" method.

The special considerations considering the two major oral diseases are:

- The diseases are strongly age related.
- The diseases exist in all populations, varying only in severity and prevalence.
- Dental caries is irreversible and therefore information on previous disease experience can be got.
- There is excessive documentation on variation of profiles of dental caries for population groups with different socioeconomic levels and environmental conditions.



The “pathfinder method” is a stratified cluster sampling technique, which aims to include the most important population subgroups likely to have differing disease levels. It also proposes appropriate numbers of subjects in specific index age groups in any one location. In this way, reliable and clinically relevant information for planning is obtained at minimum expense.

Classification of Pathfinder Survey

Pathfinder surveys are of two types depending on the number and type of sampling sites and age groups included:

- Pilot
- National

Pilot Survey

A pilot survey is one that includes only the most important subgroups in the population and only one or two index ages, usually 12 years and one other age group. Such a survey provides the minimum amount of data needed to commence planning. Additional data should then be collected to provide a reliable baseline for implementing of services.

National Pathfinder Survey

A national pathfinder survey incorporates sufficient examination sites to cover all important subgroups of the population that may have differing disease levels or treatment needs and at least three of the age groups or index ages. This type of survey design is suitable for the collection of data for the planning and monitoring of services in all countries whatever the level of disease, availability of resources or complexity of services. In a large country, a larger number of sampling sites is needed. However, the number and distribution of sampling sites depend upon the specific objectives of the study. Sampling sites are usually chosen so as to provide information on population groups likely to have different levels of oral disease, e.g. cities, small towns or ethnic groups. Once the different groups are decided upon, random sampling of subjects within the groups is done.

The recommended index ages and age groups are, 5, 12, 15, 35-44 and 65-74 years.

5 years: Children should be examined between their 5th and 6th birthdays. This age is of interest in relation to levels of caries in the primary dentition which may exhibit changes over a shorter time span than the permanent dentition.

(In some countries, 5 years is the age at which children begin primary school).

12 years: This age is especially important as it is generally the age at which children leave primary school and is the last age at which a reliable sample may be obtained easily through the school system. Also, it is at this age, that all permanent teeth, except third molars, will have erupted. For these reasons, 12 years has been chosen as the global monitoring age for caries for international comparisons and monitoring of disease trends.

In some countries, if many children do not attend school, two or three groups of non-attenders should be surveyed from different areas, so as to compare their oral health status with that of the attenders.

15 years: At this age, the permanent teeth have been exposed to the oral environment for 3-9 years. The assessment of caries prevalence is therefore often more meaningful than at 12 years of age. This age is also important for the assessment of periodontal disease indicators in adolescents.

35-44 years: [Mean 40 years]: This age group is the standard monitoring group for health conditions of adults. The full effect of dental caries, the level of severe periodontal involvement and the general effects of care provided can be monitored using data for this age group.

65 -74 years: [Mean 70 years]: This age group has become more important with the changes in age distribution and increases in life span that are now occurring. Data for this group are needed both for planning appropriate care for the elderly and for monitoring the overall effects of oral care services in a population.

The number of subjects in each index age group to be examined ranges from a minimum of 25 to 50 for each cluster or sampling site, depending on the expected prevalence and severity of oral disease.

INDICES USED IN ROUTINE DENTAL PRACTICE

Definition

Russel A I defined index "as a numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits, which is designed to permit and facilitate comparison with other populations classified by the same criteria and methods"

Criteria for Selecting an Index

- 1. The index must be simple to use and calculate.
- 2. The index should permit the examination of many people in a short period of time. The index should require minimum armamentarium and expenditure.
- 3. The index should have the criteria which defines its components clear and readily understandable so as to promote maximum intra and inter examiner reproducibility.
- 4. The index should be as free as possible from subjective interpretation.
- 5. The index should define clinical conditions objectively.
- 6. The index should be highly reproducible in assessing a clinical condition when used by one or more examiners.
- 7. The index should be amenable to statistical analysis.
- 8. The index should be strongly related numerically to the clinical stages of the specific disease under investigation.
- 9. The index should be equally sensitive throughout the scale, if it relates the severity of a variable.
- 10. The index should not cause discomfort to the patient and should be acceptable to the patient.

Oral Hygiene Index-Simplified (OHI-S Index)

The simplified oral hygiene index (OHI-S) was introduced in 1964 by John C. Greene and Jack R. Vermillion

Instruments used: Mouth mirror, explorer

It has two components: the debris index and the calculus index

Teeth selected (Fig. 27.1): 16 (buccal surface), 11 (labial surface), 26 (buccal surface), 36 (lingual surface), 31 (labial surface) and 46 (lingual surface)

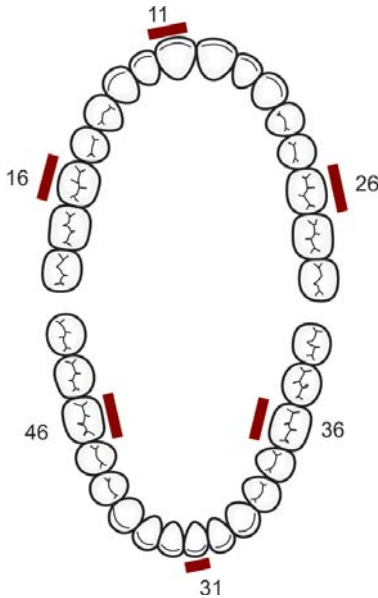


Fig. 27.1: Diagrammatic representation of the different tooth and its surfaces to be checked

Criteria for classifying debris (Fig. 27.2)	
Scores	Criteria
0	No debris or stain present
1	Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered
2	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface.
3	Soft debris covering more than two thirds of the exposed tooth surface.

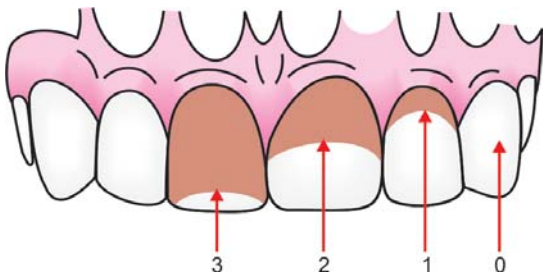


Fig. 27.2: Diagrammatic representation of the criteria used for scoring debris

**Criteria for classifying calculus**

Scores	Criteria
0	No calculus present
1	Supragingival calculus covering not more than third of the exposed tooth surface.
2	Supragingival calculus covering more than one-third but not more than two-thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supragingival calculus covering more than two-third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

Calculation

- After the scores for debris and calculus are recorded, the Index values are calculated.
- For each individual, the debris scores are totaled and divided by the number of surfaces scored. At least two of the six possible surfaces must have been examined for an individual score to be calculated.
- The score for a group or individual is obtained by computing the average of the individual scores.
- The average individual or group score is known as the Simplified Debris Index (DI-S).
- The same methods are used to obtain the calculus scores or the Simplified Calculus Index (CI-S).
- The average individual or group debris and calculus scores are combined to obtain the Simplified Oral Hygiene Index.

The CI-S and DI-S values may range from 0 to 3:

Good: 0.0 - 0.6

Fair: 0.7 - 1.8

Poor: 1.9 - 3.0

The OHI-S values may range from 0 to 6:

Good: 0.0-1.2

Fair: 1.3 - 3.0

Poor: 3.1 - 6.0

Recording Form for DI-S and CI-S

16	11	26	
46	31	36	Score

Plaque Index

This index was described by Sillness and Loe in the year 1964

Instruments used: Mouth mirror, explorer

This index can be used both as a simplified index or a full mouth index.

Teeth selected: 16, 12, 24, 36, 32, 44

Surfaces examined: The labial or buccal surface are divided into mesiofacial, facial and distofacial. The palatal or lingual surface is considered as a single surface. The recording format is given in Fig. 27.3

DF	F	MF

Palatal Surface

Fig. 27.3: Columns made for recording the surfaces for individual tooth

Scoring Criteria

The teeth have to be dried before examination.

Score 0 - No visible plaque. When a probe is passed along the cervical portion of the tooth surface no plaque adheres to the tip of the explorer.

Score 1 - No visible plaque. When a probe is passed along the cervical portion of the tooth surface a film of plaque adheres to the tip of the explorer.

Score 2 - A thin to moderate accumulation of plaque is seen on the tooth surface at the cervical portion of the crown.



Score 3 - Abundant of plaque is seen on the tooth surface at the cervical portion of the crown.

Individual plaque index is calculated as follows:

Plaque score for each tooth is calculated by adding the plaque scores of mesiofacial, facial, distofacial, palatal surfaces and dividing it by four. The individual scores of all the teeth are added and divided by the total number of teeth examined.

The patient can be evaluated based on the plaque index score as :

Excellent - 0

Good - 0.1 - 0.9

Fair - 1.0 - 1.9

Poor - 2.0 - 3.0

Gingival Index

This index was developed by Loe And Sillness in the year 1963.

In this method the severity of gingivitis is assessed.

Instruments used: Mouth mirror, periodontal probe

This index can be used both as a simplified index or a full mouth index.

Teeth selected: 16, 12, 24, 36, 32 and 44

Surfaces examined: The labial or buccal gingival is divided into mesiofacial papilla, mid facial margin and distofacial papilla. The palatal or lingual gingiva is considered as a single surface. The recording format is the same as for plaque index, given in Fig. 27.3.

The gingiva is scored based on the following scoring criteria:

Score 0 - Normal gingiva. No signs of gingivitis

Score 1 - Mild inflammation. Slight change in color, mild edema and no bleeding on probing

Score 2 - Moderate inflammation. Moderate glazing, redness, edema. Bleeds on probing

Score 3 - Severe inflammation. Marked redness, hypertrophy, ulcerations. Bleeds spontaneously.

Calculation

Gingival score for each tooth is calculated by adding the gingival scores of mesiofacial, facial, distofacial, palatal surfaces and dividing it by four. The individual scores

of all the index teeth are added and divided by the total number of teeth examined.

The patient can be evaluated based on the gingival index score as :

Mild gingivitis - 0.1-1.0

Moderate gingivitis - 1.1-2.0

Severe gingivitis - 2.1 - 3.0

The Decayed-Missing-Filled Index (DMF Index)

This index was introduced by Henry Klein, Carrole E. Palmer and Knutson J W in 1938.

Instruments used: Mouth mirror and explorer or a CPI probe (WHO 1997)

The DMFT index is an irreversible index, which measures the total lifetime caries experience.

D describes decayed teeth

M describes missing teeth due to caries

F describes restored teeth due to caries

All the teeth in oral cavity are examined, the teeth not included are

1. Third molars
2. Unerupted teeth/ congenitally missing teeth / supernumerary teeth
3. Teeth extracted or lost for reasons other than caries
4. Teeth restored for reasons other than for caries like trauma.

Rules in Recording DMFT

1. No tooth must be counted more than once
2. Decay, missing and filled teeth are recorded separately
3. Recurrent caries adjacent to restorations is considered as decay
4. List only those teeth as missing, those which have been lost due to caries. Also included should be those teeth which are so badly decayed that they are indicated for extraction
5. A tooth may have several restorations but it is counted as one
6. Deciduous teeth are not included in a DMF count
7. Tooth is considered erupted when occlusal surface or incisal edge is exposed to oral cavity



8. A tooth is considered to be present even though the crown has been destroyed and only the roots are left.

WHO Modification of DMF Index (1986)

1. All third molars are included
2. Temporary restorations are considered as 'D', decayed
3. Only carious cavities are considered as 'D', decayed.

Calculation of DMFT Index

All the decayed, missing and filled components are added separately to get the DMF score for that patient. Values for permanent and deciduous teeth should not be added, they should be kept separate.

DMFS-

A more detailed index is DMF/dmf calculated per tooth surface, DMFS/dmfs. Molars and premolars are considered as having 5 surfaces, anterior teeth 4 surfaces. Maximum value for DMFS comes to 128 for 28 teeth and 148 if third molars are included.

The rules and criteria are the same as for DMFT/dmft. Instead of calculating the number of decayed teeth, here the number of decayed surfaces is calculated. When a tooth is missing due to caries, the missing tooth is given the score of 5 for posterior tooth and 4 for anterior tooth. The decayed, missing and filled surfaces are added to get the DMFS score for that patient.

Caries Indices for Deciduous Dentition

'def' index

This index was developed by Gruebbel A.O in the year 1944. The basic principle and rules are the same as that for the DMF index.

During the developmental period, deciduous teeth are shed physiologically and some teeth might have been extracted due to caries. In this situation it might be difficult for the parent to provide the exact reason for the loss of a particular tooth. To avoid this problem, the 'm' component of the dmft/dmfs index has been replaced by the 'e' component, where 'e' denotes

indicated for extraction. It includes those teeth that are missing as well as those present in the oral cavity and needs to be extracted.

'DMF' Index

This index is used in children before the age of exfoliation, 7 to 12 years. The principles and rules are the same as that for the DMF index. It can be used to determine decayed-missing-filled teeth (DMFT) or decayed-missing-filled surfaces (DMFS).

Values for permanent and deciduous teeth should never be added together.

According to the WHO (1997), codes are used to denote the dentition status

Section 1.01	Code		Condition/status
Primary teeth	Permanent teeth		
Crown	Crown	Root	
A	0	0	Sound
B	1	1	Decayed
C	2	2	Filled, with decay
D	3	3	Filled, no decay
E	4	-	Missing, as a result of caries
-	5	-	Missing, any other reason
F	6	-	Fissure sealant
G	7	7	Bridge abutment, special crown or veneer/implant
-	8	8	Unerrupted tooth (crown)/unexposed root
T	T	-	Trauma (fracture)
-	9	9	Not recorded

0 (A). Sound crown: A crown is recorded as sound if it shows no evidence of treated or untreated clinical caries. The stages of caries that precede cavitation, as well as other conditions similar to the early stages of caries, are excluded because they cannot be reliably diagnosed. Thus, a crown with the following defects, in the absence of other positive criteria, should be coded as sound:

- White or chalky spots
- Discolored or rough spots that are not soft to touch with a metal CPI probe
- Stained pits or fissures in the enamel that do not have visual signs of undermined enamel, or softening of the floor or walls detectable with a CPI probe



- Dark, shiny, hard, pitted areas of enamel in a tooth showing signs of moderate to severe fluorosis
- Lesions that, on the basis of their distribution or history, or visual/tactile examination, appear to be due to abrasion

Sound root: A root is recorded as sound when it is exposed and shows no evidence of treated or untreated clinical caries. (Unexposed roots are coded 8.)

1 (B). Decayed crown: Caries is recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity, undermined enamel, or a detectably softened floor or wall. A tooth with a temporary filling, or one which is sealed (code 6 (F)) but also decayed, should also be included in this category. In case where the crown has been destroyed by caries and only the root is left, the caries is judged to have originated on the crown and therefore scored as crown caries only. The CPI probe should be used to confirm visual evidence of caries on the occlusal, buccal and lingual surfaces. Where any doubt exists, caries should not be recorded as present.

1 (B). Decayed root: Caries is recorded as present when a lesion feels soft or leathery to probing with the CPI probe. If the root caries is discrete from the crown and will require a separate treatment, it should be recorded as root caries. For single carious lesions affecting both the crown and the root, the likely site of origin of the lesion should be recorded as decayed. When it is not possible to judge the site of origin, both the crown and the root should be recorded as decayed.

2 (C). Filled crown, with decay: A crown is considered filled, with decay, when it has one or more permanent restorations and one or more areas that are decayed. No distinction is made between primary and secondary caries (i.e., the same code applies whether or not the carious lesions are in physical association with the restoration(s)).

2 (C). Filled root, with decay: A root is considered filled, with decay, when it has one or more permanent restorations and one or more areas that are decayed. No distinction is made between primary and secondary caries.

In the case of fillings involving both the crown and the root, judgement of the site of origin is more difficult. For any restoration most likely site of the primary carious lesion is recorded as filled, with decay. When it is not

possible to judge the site of origin of the primary carious lesion, both the crown and the root should be recorded as filled, with decay.

3 (D). Filled crown, with no decay: A crown is considered filled, without decay, when one or more permanent restorations are present and there is no caries anywhere on the crown. A tooth that has been crowned because of previous decay is recorded in this category. (A tooth that has been crowned for reasons other than decay, e.g. a bridge abutment, is coded 7 (G).)

3 (D). Filled root, with no decay: A root is considered filled, without decay, when one or more permanent restorations are present and there is no caries anywhere on the root.

In the case of fillings involving both the crown and the root, judgement of the site of origin is more difficult. For any restoration involving both the crown and the root, the most likely site of the primary carious lesion is recorded as filled. When it is not possible to judge the site of origin, both the crown and the root should be recorded as filled.

4 (E). Missing tooth, as a result of caries: This code is used for permanent or primary teeth that have been extracted because of caries and is recorded under coronal status. For missing primary teeth, this score should be used only if the subject is at an age when normal exfoliation would not be a sufficient explanation for absence.

Note: The root status of a tooth that has been scored as missing because of caries should be coded "7" or "9".

In some age groups, it may be difficult to distinguish between unerupted teeth (code 8) and missing teeth (code 4 and code 5). Basic knowledge of tooth eruption patterns, the appearance of the alveolar ridge in the area of the tooth space in question, and the caries status of other teeth in the mouth may provide helpful clues in making a differential diagnosis between unerupted and extracted teeth. Code 4 should not be used for teeth judged to be missing for any reason other than caries. For convenience, in fully edentulous arches, a single "4" should be placed in boxes 66 and 81 and/or 114 and 129, as appropriate, and the respective pairs of numbers linked with straight lines.

5 (-). Permanent tooth missing, for any other reason: This code is used for permanent teeth judged to be



absent congenitally, or extracted for orthodontic reasons or because of periodontal disease, trauma, etc. As for code 4, two entries of code 5 can be linked by a line in cases of fully edentulous arches.

Note: The root status of a tooth scored 5 should be coded "7" or "9".

6 (F). Fissure sealant: This code is used for teeth in which a fissure sealant has been placed on the occlusal surface; or for teeth in which the occlusal fissure has been enlarged with a rounded or "flame-shaped" bur, and a composite material placed. If a tooth with a sealant has decay, it should be coded as 1 or B.

7 (G). Bridge abutment, special crown or veneer: This code is used under coronal status to indicate that a tooth forms part of a fixed bridge, i.e., is a bridge abutment. This code can also be used for crowns placed for reasons other than caries and for veneers or laminates covering the labial surface of a tooth on which there is no evidence of caries or a restoration.

Note: Missing teeth replaced by a bridge are coded 4 or 5, under coronal status, while root status is scored 9.

Implant: This code is used under root status to indicate that an implant has been placed as an abutment.

8 (-). Unerupted crown: This classification is restricted to permanent teeth and used only for a tooth space with an unerupted permanent tooth but without a primary tooth. Teeth scored as unerupted are excluded from all calculations concerning dental caries. This category does not include congenitally missing teeth, or teeth lost as a result of trauma, etc. For differential diagnosis between missing and unerupted teeth, see code 5.

8 (-). Unexposed root: This code indicates that the root surface is not exposed, i.e. there is no gingival recession beyond the CEJ.

T (T). Trauma (fracture): A crown is scored as fractured when some of its surface is missing as a result of trauma and there is no evidence of caries.

9 (-). Not recorded: This code is used for any erupted permanent tooth that cannot be examined for any reason (e.g. because of orthodontic bands, severe hypoplasia, etc.).

The D-component includes all teeth with codes 1 or 2.

The M-component comprises teeth with code 4 in subjects under 30 years of age, and teeth coded 4 or 5 for subjects 30 years and older, i.e. missing due to caries or for any other reason.

The F-component includes only teeth with code 3.

The basis for DMFT calculations is 32, i.e. all permanent teeth including wisdom teeth and for dmft calculations is 20.

Teeth coded 6 (fissure sealant) or 7 (bridge abutment, special crown or veneer/implant) are not included in calculations of the DMFT.

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Chapter 28



Dental Auxiliaries

1. Introduction
2. Definition
3. Classification
 - WHO classification 1967
 - Revised classification
4. Non-operating auxiliary
 - Dental surgery assistant
 - Dental secretary/receptionist
 - Dental laboratory technician
 - Dental health educator
4. Operating Auxiliary
 - School dental nurse [New Zealand type]
 - Dental therapist
 - Dental hygienist
 - Expanded function dental auxiliary



INTRODUCTION

Socrates, in defining the ideal state, gives as a prerequisite that men should divide labor, certain men becoming expert in certain fields, others in other fields and all working as a team for the common good.

DEFINITION

A dental auxiliary is a person who is given responsibility by a dentist, so that he or she can help the dentist render dental care, but who is not himself or herself qualified with a dental degree.

The duties undertaken by dental auxiliaries range from simple tasks, such as sorting instruments, to relatively complex procedures which form part of the treatment of patients.

CLASSIFICATION OF DENTAL AUXILIARIES

They may be classified according to the training they have received, the tasks they are expected to undertake and the legal restrictions placed upon them.

WHO Classification: [suggested at the conference conducted by the WHO in New Delhi in 1967]

1. *Non-operating Auxiliaries*
 - A. Clinical: This is a person who assists the professional [dentist] in his clinical work, but does not carry out any independent procedures in the oral cavity.
 - B. Laboratory: This is a person who assists the professional by carrying out certain technical laboratory procedures.
2. *Operating Auxiliary*: This is a person who, not being a professional is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional.

Revised Classification

1. Non-operating Auxiliary:
 - A. Dental Surgery Assistant
 - B. Dental Secretary/Receptionist

- C. Dental Laboratory Technician
 - D. Dental Health Educator
2. *Operating Auxiliary*:
 - A. School Dental Nurse [New Zealand Type]
 - B. Dental Therapist
 - C. Dental Hygienist
 - D. Expanded Function Dental Auxiliary

Dental Surgery Assistant

- A dental assistant is a non-operating auxiliary who assists the dentist or dental hygienist in treating patients
- They are not legally permitted to treat patients independently.
- A dental assistant may only work under the supervision of a licensed dentist, carrying out duties prescribed by the dentist

The first dental assistant was hired by Dr. C. Edmund Kells in 1885 as a "lady in attendance" so that, female patients could respectfully come to his clinic unattended

The duties of the dental assistants are:

- Reception of the patient.
- Preparation of the patient, for any treatment, he or she may need.
- Preparation and provision of all necessary facilities such as mouthwashes and napkins.
- Sterilization, care and preparation of instruments.
- Preparation and mixing of restorative materials, including both filling and impression materials.
- Care of the patient after treatment until he or she leaves, including clearing away of instruments and preparation of instruments for rinse.
- Preparation of the surgery for the next patient.
- Presentation of documents to the surgeon for his completion and filing of these.
- Assistance with X-ray work and the processing and mounting of X-rays.
- Instruction of the patient, where necessary, in the correct use of the toothbrush.
- Aftercare of persons who have had general anesthetics.



Four Handed Dentistry (Fig. 28.1): The term four-handed dentistry is given to the art of seating both the dentist and the dental assistant in such a way that both are within easy reach of the patient's mouth. The patient is in a fully supine position. The assistant will hand the dentist the particular instrument he needs. She will also perform additional tasks such as retraction or aspiration. The dentist can thus keep his hands and eyes in the field of operation and work with less fatigue and greater efficiency



Fig. 28.1: Four handed dentistry

Dental Secretary/Receptionist

- This is a person who assists the dentist with his secretarial work and patient reception duties.

Dental Laboratory Technician

- A dental laboratory technician is a non-operating auxiliary who fulfills the prescriptions provided by dentists regarding the extraoral construction and repair of oral appliances and bridgework.
- The title, "dental mechanic" is also applied to this type of auxiliary.
- His specific duties, in addition to the casting of models from impressions made by the dentist, include the fabrication of dentures, splints, orthodontic appliances, inlays, crowns and special trays.
- Dental laboratory technicians may be employed by dentists in private or public health practice, they may

be self-employed and accept work from dentists in the area or they may be employed by commercial laboratories.

- Denturist is a term applied to those dental laboratory technicians, who are permitted in some states in US. and elsewhere to fabricate dentures directly for patients without a dentist's prescription.

Dental Health Educator

- This is a person who instructs in the prevention of dental disease
- They may also be permitted to carry out certain preventive procedures such as to conduct fluoride mouth-rinsing programs to groups of school children.
- They are not however, allowed to undertake any intra-oral procedures.

School Dental Nurse [New Zealand Type]

This is a person who is permitted to diagnose dental disease and to plan and carry out certain specified preventive and treatment measures, including some operative procedures for the treatment of dental caries and periodontal disease, in defined groups of people, usually school children, under the direction of a dentist, but not necessarily in his presence.

He or she has to refer to the dentist those patients requiring diagnosis or treatment that he or she is not able or legally entitled to carry out.

Duties of nurses

- Oral examination
- Prophylaxis
- Topical fluoride application
- Advice on dietary fluoride supplements
- Administration of local anesthetic
- Cavity preparation and placement of amalgam fillings in primary and permanent teeth
- Pulp capping
- Extraction of primary teeth
- Individual patient instruction in toothbrushing and oral hygiene
- Classroom and parent-teacher dental health education



- Referral of complex cases to a dentist in the area.

A school dental nurse may work only in the Public Health Dental Service. A supervising dentist of the school dental service is expected to make periodic visits to ensure that she is providing an effective service.

The training for the New Zealand School Dental Nurse began in 1921, in Wellington and they began treatment in 1923.

Dental Therapist

This is a person, who is permitted to carry out, to the prescription of a supervising dentist, certain specified preventive and treatment measures including the preparation of cavities and restoration of teeth.

Dental Hygienist

- This is a person who is permitted to carry out, to the prescription of a supervising dentist, certain specified preventive and treatment measures, including some operative procedures in the treatment of periodontal disease.
- He is not permitted to carry out any operative procedures for the treatment of dental caries.

The usual functions of the dental hygienist are:

- Cleaning of mouths and teeth, with particular attention to calculus and stains.
- Topical application of fluorides, sealants and other prophylactic solutions.
- Screening or preliminary examination of patients as individuals or in groups, such as school children or industrial employees, so that they may be referred to dentists for treatment.
- Instruction in oral hygiene.
- Resource work in the field of dental health education.

In 1905 Dr. Alfred C. Fones of Bridgeport, Connecticut trained Mrs. Irene Newman in the procedures of dental prophylaxis. In 1906, she was at work in Dr. Fones' office and became the first dental hygienist. The first training school for dental hygienists came into being in November 1913.

Expanded Function Dental Auxiliary

- This is a person who is permitted to carry out certain specified preventive and treatment measures including "reversible" parts of some operative procedures in the treatment of dental caries.
- They are also called expanded function dental assistants, expanded duty dental auxiliaries or simply as auxiliaries.
- Tasks include the placing of restorations into cavities that have been prepared by a dentist.

Their functions

- Placing and removing rubber dams.
- Placing and removing temporary restorations.
- Placing and removing matrix bands.
- Condensing and carving amalgam restorations in previously prepared teeth.
- Placing of silicate and acrylic restorations in previously prepared teeth.
- Applying the final finish and polish to the previously listed restorations.

The practice of dentistry involves a personal relationship between the dentists, dental auxiliaries and the patients who elect to seek professional service from them. Because of the unique privileges granted to them, the members of the dental profession have the responsibility of providing a high standard of service to their patients and they should assume their duties freely and voluntarily.

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Chapter 29



Practice Management

1. Introduction
2. Components of a Successful Dental Practice
 - Personnel systems
 - Patient systems
 - Operational systems
3. Production and Collections
4. The Dental Office Setting



INTRODUCTION

Practice management, in addition to being a method to increase income, also includes creating an efficient practice that has a low stress level and where there is open communication between the dental staff and the patients.

Practice management aims at developing management skills to achieve a good practice, harmonious staff, satisfied patients and a good income.

COMPONENTS OF A SUCCESSFUL DENTAL PRACTICE

Success of dental practice depends on the office staff, patients and the entire operational system.

Personnel Systems

- A charming friendly and professional staff is vitally important for practice success.
- The number of employees in an office varies depending upon the type of practice and patient load.
- Persons involved in patient management should be warm, empathetic with an aptitude for learning and capacity to learn and apply from past experience in new situations.
- Every new employee must be oriented on the first day of employment and a written training schedule must be given. Orientation may begin with a review of the office manual which outlines the duties, obligations and mutual expectations of the employee and employer and clarifies office policies. A training period may be necessary if the person is very new with no experience.
- Fair salaries and good benefits are necessary to avoid job dissatisfaction.
- Motivated and hard working staff members must be recognized and encouraged and this also indirectly motivates other staff members to perform better.

Patient Systems

- As the saying goes 'First impression is the best impression' a good first appointment experience

provides the foundation for an enjoyable long-term relationship with patients and parents.

- The dental receptionist should be adequately trained in the skills of communication as she is the first person to greet the new patient.
- At the first visit, patient's records are made. Communication with the parents is very important. Informal dialogues with the child will help reduce any anxiety in the child.
- It is better not to have a hard and fast rule that parents remain in the reception area. Parents can be helpful in calming the child, holding radiographic films and helping to restrain the child, who would be less frightened than if restrained by strangers. It is important to remember to inform the parent before any procedure to avoid misunderstandings.
- Care should be taken to schedule the first appointment of very young child. Appointments should be avoided during the sleep time.
- An appointment time should be maintained to fully utilize the dentist's time throughout the day.

Operational Systems

- It is very important to schedule and document all the necessary activities necessary for the smooth functioning of the dental clinic. First most important is the efficient appointment scheduling which makes the office functioning pleasant whereas poor scheduling creates a hectic, stressful environment for patients and staff members.
- Block scheduling can also be used. In block scheduling, patients with similar treatments are given appointments in a pre-determined period. For example, more difficult and lengthy procedures such as pulpotomies, crown, composite restorations, and procedures for pre-school children are scheduled early in the day when the dentist, auxiliary personnel and patients are fresh. Less difficult procedures such as simple operative treatments, orthodontic adjustments and hygiene appointments for older children may be scheduled in the afternoons. Appointments just before lunch and the in late afternoon should be reserved for the simplest procedures such as suture removals, simple



extractions, eruption checks and post-trauma examinations. Sedated and difficult patients and those needing hospitalization require the dentist's undivided attention, so their treatment should be scheduled weekly at a particular time.

- Patients who miss their appointments should be separately listed and seen that they are not lost. They should be contacted periodically and invited to re-schedule.

PRODUCTION AND COLLECTIONS

For the dental practice to operate profitably, high quality dental treatment must be provided in an efficient manner.

A production goal is important for any successful enterprise. It determines the amount of money that must be charged to reach the Break-Even Point (BEP) and enjoy a certain amount of profit. The BEP is the amount of money needed each year to pay all office expenses, both fixed as well as variable costs. Fixed cost includes staff salaries and benefits, occupancy costs, administrative costs, continuing education, taxes, insurance and repayment of money borrowed to finance the practice start up or purchase. Variable costs usually include laboratory fees and dental supplies, the cost of which varies depending upon patient load.

Office supplies and dental supplies account for a considerable bulk of the gross income. Proper inventory control methods help in saving quite an amount on supplies. An inventory control card should be maintained for each item purchased. The card should contain information such as name, address and phone number of each preferred vendor, an alternate vendor and a third vendor, if desired; the price of the item, the date of the pricing and the time needed for delivery. The preferred vendor is chosen not only because of the low price but also because of other factors like best availability or the fastest delivery. The alternate vendor may be more expensive but deliver at short notice. Whenever an item is ordered, the date and amount ordered must be noted. Ordering supplies on contract for 1 year at dental conventions where there are special prices from manufacturers, results in substantial savings. Therefore, inventory control and proper timing of purchases can

considerably reduce the total cost of supplies, indirectly increasing the profits.

The following factors must be considered when setting fees:

1. The dentist's and assistant's time required to do the procedure.
2. The cost of operations per hour, including fixed as well as variable costs.
3. Prevailing professional fees in the area.

Fees must be reviewed annually and if necessary, raised more than the inflation rate to continue to generate adequate margin of profit. Most patients accept and may not even notice small adjustment in fees. Problems may arise, when a dentist who does not increase fees for several years, implements an increase of 20% or higher. Most patients notice and complain about such a large increase. Fee increase should not be announced to patients. However, staff members should be informed about the expenses such as laboratory fees and office supplies and utilities so as to allow them to understand the necessity of regular fee increases.

THE DENTAL OFFICE SETTING (FIG 29.1)

Primarily, the dental office projects how the dentist feels about his office. It is important that patients should not be intimidated by the office and the dentist also needs to be comfortable in his working environment.



Fig. 29.1: Dental Office Setting



The furniture in the reception area must be durable, esthetic and comfortable. Otherwise patients may wonder if the quality of dental work is as cheap as the furnishing or, if the reception area is excessively lavish, patients may wonder if the dental work is going to be more expensive than usual.

Sound proofing is an important consideration in the pediatric dental office. Buffering the noise from the reception area is advised by having a second waiting area between the operating and reception/waiting areas. Having a "quiet room" where difficult patients can be treated is also useful. The waiting room should be carefully decorated, so that safety comes first and the area should require little or no supervision.

When equipping the dental operator, one should purchase equipment that is functional and durable with a track record of minimum repair. It is important to have equipment that will enable the work to be performed with the greatest of ease. Another necessary equipment in the dental office is the computer. A computer is one of the easiest ways to maintain patients record. Dental charts are legal documents and must be stored for at least 7 years after the patient leaves the practice.

Daily or monthly statistics regarding the number of patients, the type of treatment given, the fees and the expenses can be documented in a single-sheet format which allows for quick evaluation and comparison.

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Chapter 30



General Epidemiology

1. Introduction
2. Definitions
3. The Components of Epidemiology
4. Aims of Epidemiology
5. Principles of Epidemiology
6. Epidemiologic Methods
 - Descriptive studies
 - Analytical studies
 - Experimental or intervention studies
7. Uses of Epidemiology



INTRODUCTION

Epidemiology has its origins in the idea first expressed over 2000 years ago by Hippocrates and others, that environmental factors can influence the occurrence of disease.

Epidemiology is derived from the word epidemic (epi-among; demos=people; logos=study), which is a very old word dating back to the 3rd Century BC.

DEFINITIONS

"The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control health problems" (Last 1988).

THE COMPONENTS OF EPIDEMIOLOGY

The three components of epidemiology are studies of disease frequency, studies of the distribution and studies of the determinants. Each of these components confers an important message.

Disease Frequency

It involves the measurement of frequency of disease, disability or death, and summarizing this information in the form of rates and ratios like prevalence rate and incidence rate. These rates may yield important clues to disease etiology, which forms a vital step in the development of strategies for prevention and control of health problems.

Prevalence Rate

Disease prevalence refers to all current cases existing at a given point in time or over a period of time in a given population.

$$P = \frac{\text{Number of people with the disease or condition at a specified time}}{\text{Number of people in the population at risk at the specified time}} \times 10^n$$

Prevalence rate is often expressed as cases per 1000 or per 100 population (10^n).

Prevalence is of two types:

1. *Point prevalence*: If the data has been collected for one point in time.
2. *Period prevalence*: If the data has been collected during a specified period of time.

Factors influencing prevalence rate:

Uses of prevalence:

1. To estimate the magnitude of disease problems in the community and identify high risk groups.
2. For administration and planning of services.

Incidence Rate

Incidence rate is defined as "the number of new cases occurring in a defined population during a specified period of time".

Incidence rate (I) is calculated as follows:

$$I = \frac{\text{Number of people who get a disease in a specified period}}{\text{Sum of the length of time during which each person in the population is at risk}} \times 10^n$$

The numerator strictly refers only to first events of disease. The units of incidence rate must always include a dimension of time (date, month, year).

The denominator is the sum of all the disease free time periods in the defined time period of the study. This is usually calculated approximately by multiplying the average size of the study population by the length of the study period.

$$\text{Prevalence} = \frac{\text{Interrelationships of prevalence and incidence}}{\text{Incidence} \times \text{Average duration of disease}}$$

Uses of incidence:

1. To take action to control disease
2. For research into disease etiology and distribution
3. To determine the efficacy of preventive and therapeutic measures.

Distribution of Disease

Disease and health are not uniformly distributed in human populations. An important function of



epidemiology is to study the distribution patterns in the various subgroups of the population by time, place and person. An important outcome of this study is the formulation of an etiological hypothesis. This aspect of epidemiology is known as descriptive epidemiology.

Determinants of Disease

A unique feature of epidemiology is to test etiological hypotheses and identify the underlying causes of disease. This aspect of epidemiology is known as analytical epidemiology.

AIMS OF EPIDEMIOLOGY

- To describe the distribution and size of disease problems in human populations
- To identify etiological factors in the pathogenesis of disease
- To provide data needed for planning, implementation of and evaluation of services for the prevention, control and treatment of disease and to the setting up of priorities among these services.

PRINCIPLES OF EPIDEMIOLOGY

- Exact observation
- Correct interpretation
- Rational explanation
- Scientific construction

EPIDEMIOLOGIC METHODS

1. Descriptive studies
2. Analytical studies
3. Experimental or intervention studies

DESCRIPTIVE STUDIES

They are the first phase of an epidemiologic investigation. These studies formulate an etiological hypothesis.

Procedures in Descriptive Epidemiology

1. Defining the population to be studied
2. Defining the disease under study

3. Describing the disease by:
 - time
 - place
 - person
4. Measurement of disease
5. Comparing with known indices
6. Formulation of an etiological hypothesis.

Defining the Population to be Studied

The population should be described in terms of the total number and composition such as age, sex, occupation and cultural characters.

The defined population can be the whole population or a representative sample taken from it. The defined population should be large enough, stable, without migration into or out of the area and community participation should be forthcoming.

The defined population provides the denominator for calculating rates.

Defining the Disease Under Study

To obtain an accurate estimate of disease in a population, a definition that is both precise and valid is needed to identify those who have the disease from those who do not. An operational definition is a definition by which the condition can be identified and measured in the defined population with a degree of accuracy. Once established, the definition must be adhered to throughout the study.

Describing the Disease: By Time, by Place, by Person

By time

There are three kinds of time fluctuations in disease occurrence.

- i. Short-term fluctuations
- ii. Periodic fluctuations
- iii. Long-term fluctuations

- i. *Short-term fluctuations:* An epidemic is an example of a short-term fluctuation in the occurrence of a disease. An epidemic is defined as "the occurrence in a community or region of



cases of an illness or other health-related events clearly in excess of normal expectancy".

Types of epidemics:

- a. Common-source epidemics
 - Single exposure or point source epidemics
E.g. Epidemic of food poisoning
 - continuous or multiple exposure
E.g. A well of contaminated water.
- b. Propagated epidemics: Results from person-to-person transmission of an infectious agent, e.g. Epidemics of hepatitis A and polio.
- c. Slow or modern epidemics
E.g. AIDS
- ii. *Periodic fluctuations*
 - Seasonal trend
E.g. Upper respiratory tract infections
 - Cyclic trend
E.g. Mumps, automobile accidents
- iii. *Long-term or secular trends*
E.g. Coronary heart disease, cancers.

Distribution by place:

- i. International variations
- ii. National variations
- iii. Rural-urban differences
- iv. Local distributions.
 - i. *International variations:* Descriptive studies have shown that the pattern of disease is not the same everywhere. There is a marked difference between the incidence of each cancer in different parts of the world. Thus, cancer of the stomach is very common in Japan, but unusual in US. Cancers of the oral cavity are exceedingly common in India as compared to industrialized countries.
 - ii. *National variations:* Variations in disease occurrence also occur within countries or national boundaries. For example, the distribution of fluorosis has shown variations, with some parts of the country being more affected and others less affected or not affected at all. Such situations exist in every country.
 - iii. Rural/urban variations in disease distribution are also well known. These variations may be due

to differences in population density, social class, deficiencies in medical/dental care, education or environmental factors.

- iv. *Local distributions:* Inner and outer city-variations in disease frequency are best studied with the aid of 'spot maps' or 'shaded maps'. These maps show at a glance areas of high or low frequency, the boundaries and patterns of disease distribution. For example, if the map shows "clustering" of cases, it may suggest a common source of infection or a common risk factor shared by all the cases.

Migrant studies:

Migrant studies can be carried out in two ways:

- a. Comparison of disease and death rates for migrants with those of their kin who have stayed at home. This permits study of genetically similar groups but living under different environmental conditions or exposures. If the disease and death rates among migrants are similar to country of adoption over a period of time, the likely explanation would be a change in the environment.
- b. Comparison of migrants with the local population of the host country provides information on genetically different groups living in a similar environment. If the migration rates of disease and death are similar to the country of origin, the likely explanation would be genetic factors.

Distribution by person:

- a. *Age:* Age is strongly related to disease than any other single host factor. Certain diseases are more frequent in certain age groups than in others, e.g. dental caries in childhood, cancer in middle age and root caries in old age.
- b. *Sex:* Sex is another host characteristic which is often studied in relation to disease. It has been found that certain chronic diseases such as diabetes, hyperthyroidism and obesity are more common in women than in men and diseases such as lung cancer and coronary heart disease are less frequent in women.
- c. *Ethnicity:* Differences in disease occurrence have been noted between population subgroups of different racial and ethnic origin.



- d. *Marital status*: It has been found that mortality rates were always lower for married individuals than for the unmarried of the same age and sex.
- e. *Occupation*: Man's occupation from which he earns his livelihood has an important bearing on his health status. Occupation may alter the habit pattern of employees, e.g. sleep, alcohol, smoking, drug addiction, night shifts etc. It is obvious that persons working in particular occupations are exposed to particular types of risks, e.g. workers in coal mines are more likely to suffer from silicosis.
- f. *Social class*: Epidemiological studies have shown that health and disease are not equally distributed in social classes. Individuals in upper social classes have a longer life expectancy and better health and nutritional status than those in the lower social classes. Certain diseases like coronary heart disease, hypertension and diabetes have shown a higher prevalence in upper classes than in the lower classes.
- g. *Behavior*: Human behavior is increasingly looked upon as a risk factor in modern-day diseases such as coronary heart disease, cancer, obesity and accidents. The behavioral factors which have attracted the greatest attention are cigarette smoking, sedentary life, over-eating and drug abuse.
- h. *Stress*: Stress has been shown to affect a variety of variables related to patients response, e.g. susceptibility to disease, exacerbation of symptoms, compliance with medical regimen, etc.
- i. *Migration*: In India diseases like leprosy, filaria and malaria are considered to be rural problems. However, because of the movement of people from rural to urban areas these diseases have created serious problems in urban areas also.

Measurement of Disease

It is mandatory to have a clear picture of the amount of disease in the population. This information should be available in terms of mortality, morbidity and disability. Incidence can be obtained from "longitudinal" studies, and prevalence from "cross-sectional" studies. Descriptive epidemiology may use a cross-sectional or longitudinal design to obtain estimates of magnitude of health and disease problems in human populations.

Cross-sectional studies: Cross-sectional study is the simplest form of an observational study. It is based on a single examination of a cross-section of a population at one point in time. Cross-sectional studies are useful for chronic diseases.

Longitudinal studies: In longitudinal studies, observations are repeated in the same population over a prolonged period of time by means of follow-up examinations.

Comparing with Known Indices

The essence of epidemiology is to make comparisons and ask questions. By making comparisons between different populations and subgroups of the same population, it is possible to arrive at clues to disease etiology. We can also identify or define groups who are at increased risk for certain diseases.

Formulation of a Hypothesis

A hypothesis is a supposition arrived at from observation or reflection. An epidemiological hypothesis should specify the following:

1. The population—the characteristics of the persons to whom the hypothesis applies
2. The specific cause being considered
3. The expected outcome—the disease
4. The dose-response relationship—the amount of the cause needed to lead to a stated incidence of the effect
5. The time-response relationship—the time period that will elapse between exposure to the cause and observation of the effect.

Uses of Descriptive Epidemiology

1. Provide data regarding the magnitude of disease load and types of disease problems in the community
2. Provide clues to disease etiology and help in the formulation of an etiological hypothesis.
3. Provide background data for planning, organizing and evaluating preventive and curative services
4. Contributes to research by describing variations in disease occurrence by time, place and person.



ANALYTICAL EPIDEMIOLOGY

Analytical studies are the second major type of epidemiological studies.

The object is not to formulate, but to test the hypotheses.

Analytical studies comprise two distinct types of observational studies:

- a. Case control study
- b. Cohort study

From each of these study designs, one can determine:

- a. whether or not a statistical association exists between a disease and a suspected factor; and
- b. if one exists, the strength of the association.

Case Control Study

Case control studies, often called "retrospective studies" are a common first approach to test causal hypothesis.

The case control method has three distinct features:

- a. Both exposure and outcome (disease) have occurred before the start of the study
- b. The study proceeds backwards from effect to cause
- c. It uses a control or comparison group to support or refute an inference

By definition, a case control study involves two populations—cases and controls. Cases and controls must be comparable with respect to known "confounding factors" such as age, sex, occupation, social status, etc.

There are four basic steps in conducting a case control study:

1. Selection of cases and controls
2. Matching
3. Measurement of exposure, and
4. Analysis and interpretation.

Selection of Cases and Controls

The first step is to identify a suitable group of cases and a group of controls.

Selection of cases

- *Definition of a case:*
 - i. *Diagnostic criteria:* The diagnostic criteria of the disease and the stage of disease must be specified before the study is undertaken. Once the

diagnostic criteria are established they should not be altered or changed till the study is over.

- ii. *Eligibility criteria:* The second criterion is that of eligibility. A criterion customarily employed is the requirement that only newly diagnosed (incident) cases within a specified period of time are eligible than old cases or cases in advanced stages of the disease (prevalent cases).
- *Sources of cases:*
The cases may be drawn from:
 - i. *Hospitals:* The cases may be drawn from a single hospital or a network of hospitals, admitted during a specified period of time.
 - ii. *General population:* All cases of the study disease occurring within a defined geographic area during a specified period of time are ascertained. The entire case series or a random sample of it is selected for study.

Selection of controls

The controls must be free from the disease under study. They must be as similar to the cases as possible, except for the absence of the disease under study. Selection of an appropriate control group is an important prerequisite, for it is against this, we make comparisons, draw inferences and make judgements about the outcome of the investigation.

Sources of controls:

1. *Hospital controls:* The controls may be selected from the same hospitals as the cases but with different illness than the disease under study.
2. *Relatives:* The controls may also be taken up from relatives (spouses and siblings).
3. *Neighborhood controls:* The controls may be drawn from persons living in the same locality as cases, persons working in the same factory or children attending the same school.
4. *General population:* Population controls can be obtained from defined geographic areas, by taking a random sample of individuals free of the study disease.

Matching

The controls may differ from the cases in a number of factors such as age, sex, occupation, social status, etc.



Matching is defined as the process by which we select controls in such a way that they are similar to cases with regard to certain pertinent selected variables which are known to influence the outcome of disease and which, if not adequately matched for comparability, could distort or confound the results.

A "confounding factor" is defined as one which is associated both with exposure and disease and is distributed unequally in the study and control groups. A confounding factor is one that, although associated with "exposure" under investigation, is itself, a "risk factor" for the disease.

Matching can be of two types:

- *Group matching:* This may be done by assigning cases to sub-categories based on their characteristics (e.g. age, occupation) and then establishing appropriate controls.
- *Pairs matching:* For each case, a control is chosen which can be matched quite closely. Thus, if we have a 20-year old adult with a particular disease, we will search for 20-year old adult without the disease as a control. Thus, one can obtain pairs of patients and controls of the same sex, age, duration and severity of illness, etc.

Measurement of Exposure

Information about exposure should be obtained in the same manner both for cases and controls. This may be obtained by interviews, by questionnaires or by studying past records such as hospital records, employment records, etc.

Analysis

The final step is analysis, to find out:

- a. Exposure rates among cases and controls to suspected factor
- b. Estimation of disease risk associated with exposure (Odds ratio)

Exposure rates

Exposure rates among cases = $\frac{\text{cases exposed to risk factor}}{\text{total no. of cases (in percentage)}}$

Exposure rates among controls = $\frac{\text{controls exposed to risk factor}}{\text{total no. of controls (in percentage)}}$

Estimation of Risk

Persons and incidence among non-exposed.

It is given the formula:

Relative risk = Incidence among exposed/incidence among non-exposed.

A typical case control study does not provide incidence which relative risk can be calculated directly, because there is no appropriate denominator or population at risk.

Bias in Case Control Studies

Bias is any systematic error in the determination of the association between exposure and disease.

Types of bias

- a. *Bias due to confounding.* This bias is removed by matching in case control studies.
- b. *Memory or recall bias:* When cases and controls are asked questions about their past history, it may be more likely for the cases to recall the existence of certain events or factors than the controls who are healthy.
- c. *Selection bias:* The cases and controls may not be representative of cases and controls in the general population.
- d. *Berksonian bias:* It is termed after Dr. Joseph Berkson who had this problem. The bias arises because of the different rates of admission to hospitals for people with different diseases.
- e. *Interviewer's bias:* Bias may also occur when the interviewer knows the hypothesis and also knows who the cases are. This information may lead him to question cases more thoroughly than controls.

Advantages and Disadvantages of Case Control Studies

Advantages

1. Relatively easy to carry out



2. Rapid and inexpensive (compared with cohort studies)
3. Require comparatively few subjects
4. Particularly suitable to investigate rare diseases or diseases about which little is known.
5. No risk to subjects
6. Allows the study of several different etiological factors
7. Risk factors can be identified.
8. No attrition problems, because case control studies do not require follow-up of individuals into the future
9. Ethical problems minimal.

Disadvantages

1. Problems of bias.
2. Selection of an appropriate control group may be difficult
3. We cannot measure incidence, and can only estimate the relative risk
4. Does not distinguish between causes and associated factors
5. Not suited for the evaluation of therapy or prophylaxis of disease
6. Another major concern is the representativeness of cases and controls.

Cohort Study

Cohort study is another type of analytical (observational) which is usually undertaken to obtain additional evidence to refute or support the existence of an association between the suspected cause and the disease.

Cohort study is known by a variety of names, prospective study, longitudinal study, incidence study, forward-looking study.

Distinguishing Features of Cohort Studies

- a. The cohorts are identified prior to the appearance of disease under investigation
- b. The study groups, so defined, are observed over a period of time to determine the frequency of disease among them
- c. The study proceeds forwards from cause to effect.

The term "cohort" is defined as a group of who share a common characteristic or experience within a time period (e.g. age, occupation).

Indications for Cohort Studies

- a. When there is good evidence of an association between exposure and disease.
- b. When exposure is rare, but the incidence of disease high among exposed.
- c. When attrition of study population can be minimized.
- d. When ample funds are available.

In assembling cohorts, the following general considerations should be taken into account:

- a. The cohorts must be free from the disease under study.
- b. Both the groups (i.e. study and control cohorts) should be equally susceptible to the disease.
- c. Both the groups should be comparable with respect to all the possible variables, which may influence the frequency of the disease.
- d. The diagnostic and eligibility criteria of the disease must be defined beforehand.

Types of Cohort Studies

1. *Prospective cohort studies*: Is one in which the outcome has not yet occurred at the time the investigation begins.
2. *Retrospective cohort studies*: Is one in which the outcomes have all occurred before the start of the investigation. The investigator goes back in time to select his study groups from past medical or employment records and traces them forward.
3. *A combination of retrospective and prospective cohort studies*: Here the cohort is identified from past records and are assessed till date for the outcome. The same cohort is followed up prospectively into the future for further assessment of outcome.

Elements of a Cohort Study

The elements of a cohort study are:

1. Selection of study subjects
2. Obtaining data on exposure
3. Selection of comparison groups
4. Follow-up
5. Analysis



Selection of study subjects: They can be from:

- a. *General population:* When exposure is frequent, cohorts may be assembled from the general population.
- b. *Special groups :*
 - *Select groups:* These may be professional groups (e.g. doctors, nurses, lawyers) college students, volunteers etc.
 - *Exposure groups:* These groups comprise of individuals who are known to have experienced the exposure(e.g. radiologists exposed to X-rays).

Obtaining data on exposure: Information about exposure can be obtained by:

- Personal interviews or mailed questionnaires
- Review of records
- Medical examinations
- Environmental surveys.

Selection of comparison groups

- a. *Internal comparisons:* In some cohort studies, no outside comparison group is required. The comparison groups are in-built. That is, single cohort enters the study, and its members may be classified into several comparison groups according to the degrees of exposure to risk.
- b. *External comparisons:* When information on degree of exposure is not available, it is necessary to put up an external control, to evaluate the experience of the exposed group, e.g. smokers and non-smokers.
- c. *Comparison with general population rates:* If no groups are available, the mortality experience of the exposed group is compared with the mortality experience of the general population in the same geographic area as the exposed people.

Follow-up: Consists of:

- Periodic medical examination of each member
- Review of hospital records
- Surveillance of death records
- Mailed questionnaires, periodic home visits.

Analysis: The data obtained are analyzed to obtain:

- *Incidence rates*
Among cases = no. of individuals with disease in the study group/study population
Among controls=no. of individuals with disease in the controls/control population
- *Estimation of relative risk (RR)*
 $RR = \frac{\text{Incidence of disease among exposed}}{\text{Incidence of disease among non-exposed}}$
- *Estimation of attributable risk (AR)*
 $AR = \text{Incidence of disease among exposed} - \text{Incidence of disease among non-exposed}$
Incidence of disease among exposed in percentage.

Advantages and Disadvantages of Cohort Studies

Advantages

1. Incidence can be calculated
2. Several possible outcomes related to exposure can be studied simultaneously
3. Provides a direct estimate of relative risk
4. Dose-response ratios can be calculated
5. Certain forms of bias can be minimized.

Disadvantages:

1. Involves a large number of people
2. Study takes a long time
3. Attritional problems are inevitable
4. Expensive
5. Ethical problems may arise.

EXPERIMENTAL EPIDEMIOLOGY

Experimental or intervention studies are studies carried out under the direct control of the investigator. These studies involve some action, intervention or manipulation such as the deliberate application or withdrawal of a suspected cause or changing one variable in the causative chain in the experimental group while making no change in the control group and observing and comparing the outcome of the experiment in both the groups.



Aims of Experimental Studies

- a. To provide "scientific proof" of etiological (or risk) factors which may permit the modification or control of those diseases
- b. To provide a method of measuring the effectiveness and efficiency of health services for the prevention, control and treatment of disease and improve the health of the community.

Experimental studies may be conducted in animals or human beings.

Experimental studies are of two types:

1. Randomized controlled trials (those involving a process of random allocation).
2. Non-randomized or "non-experimental" trials (those departing from strict randomization for practical purposes, but in such a manner that non-randomization does not seriously affect the basis of conclusions).

In modern usage, experimental epidemiology is often equated with randomized controlled trials.

Randomized Controlled Trials (RCT)

The basic steps in conducting a RCT include the following:

1. Drawing up a protocol
 2. Selecting reference and experimental populations
 3. Randomization
 4. Manipulation or intervention
 5. Follow-up
 6. Assessment of outcome
1. *Drawing up a protocol*: The protocol specifies the aims and objectives of the study, criteria for the selection of study and control groups, size of the sample, the procedures for allocation of subjects into the study and control groups, treatments to be applied, standardization of working procedures and schedules, up to the stage of evaluation of outcome of the study.
Once a protocol has been evolved, it should be strictly adhered to throughout the study.
 2. *Selecting reference and experimental populations*:
 - a. *Reference or target population*: It is the population to which the findings of the trial, if found successful, is expected to be applicable.

A reference population may be as broad as mankind or it may be geographically limited or limited to persons in specific age, sex or social groups.

- b. *Experimental or study population*: The study population is derived from the reference population. It is the actual population that participates in the experimental study. Ideally, it should be randomly chosen from the reference population, so that it has the same characteristics as the reference population.

When an experimental population has been defined, its members are invited to participate in the study.

The participants or volunteers must fulfill the following three criteria:

- A. They must give "informed consent". That is they must agree to participate in the trial after having been fully informed about the purpose, procedures and possible dangers of the trial.
 - B. They should be representative of the population to which they belong.
 - C. They should be qualified or eligible for the trial.
- In other words, the participants must be fully susceptible to the disease under study.

Randomization: Randomization is a statistical procedure by which the participants are allocated into groups usually called "study" and "control" groups, to receive or not to receive an experimental preventive or therapeutic procedure or intervention. Randomization is an attempt to eliminate "bias" and allow for comparability. By random allocation, every individual gets an equal chance of being allocated into either group.

Randomization is best done using a table of random numbers.

Manipulation: Having formed the study and control groups, the next step is to intervene or manipulate the study (experimental) group by deliberate application or withdrawal or reduction of the suspected causal factor as laid down in the protocol.

Follow-up: This involves examination of the experimental and control group subjects at defined intervals of time, in a standard manner under the same given circumstances till final assessment of outcome.



Some losses to follow-up are inevitable due to factors such as death, migration and loss of interest. This is known as attrition.

Assessment: The final step in assessment of the outcome of the trial is in terms of:

- a. *Positive results:* that is, benefits of the experimental measure such as reduced incidence or severity of the disease.
- b. *Negative results:* that is, severity and frequency of side effects and complications, including death.

Bias may arise from errors of assessment of the outcome due to the human element. These may be from three sources:

- a. Bias on the part of the participants, who may subjectively feel better or report improvement if they knew they were receiving a new form of treatment.
- b. Observer bias, that is the investigator measuring the outcome of a therapeutic trial may be influenced if he knows beforehand the particular procedure or therapy to which the patient has been subjected to.
- c. Bias in evaluation, that is, the investigator may subconsciously give a favorable report of the outcome of the trial.

In order to reduce these problems, a technique known as "blinding" is adopted.

Blinding

Blinding can be done in three ways:

- a. *Single blind trial:* The trial is so planned that the participant is not aware whether he belongs to the study group or control group.
- b. *Double blind trial:* The trial is so planned that neither the doctor nor the participant is aware of the group allocation and the treatment received.
- c. *Triple blind trial:* The participant, the investigator and the person analyzing the data are all "blind".

Ideally, of course, triple blinding should be used but double blinding is the most frequently used method.

USES OF EPIDEMIOLOGY

1. *To study historically the rise and fall of disease in the population* The first use of epidemiology relates



Fig. 30.1: Studying the distribution and determinants of health related states and events in populations.

to this aspect, that is, study of the history of disease in human population. Health and disease pattern in a community is never constant. There are fluctuations both over short and long periods of time. Epidemiology provides a means to study disease profiles and time trends in human populations. Thus, useful projections into the future can be made and emerging health problems can be identified.

2. *Community diagnosis:* Refers to the identification and quantification of health problems in a community. This helps in laying down priorities in disease control and prevention. It can also serve as a benchmark for the evaluation of health services. It can also be a source of new knowledge about disease distribution, causation and prevention.
3. *Planning and evaluation:* Planning is essential for a rational allocation of the limited resources. Epidemiologic information about the distribution of health problems overtime and place provides the basis for planning health services. Evaluation is done to find out whether the measures undertaken to prevent a disease are effective in reducing the frequency of this disease.
4. *Evaluation of individual's risks and chances:* Making a statement about the degree of risk in a population is one of the important tasks in epidemiology. Relative risk and attributable risk needs to be calculated for a factor related to the cause of the disease.



5. *Syndrome identification*: Syndromes are identified by observing frequently associated findings in individual patients.
6. *Completing the natural history of disease*: In epidemiology, disease patterns in the community are studied in relation to agent, host and environmental factors and this facilitates the filling up of the gaps in the natural history of disease.
7. *Searching for causes and risk factors*: By relating disease to interpopulation differences and other attributes of the population examined, epidemiology tries to identify the causes of disease (Fig. 30.1).

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Chapter 31



Medical Emergencies in Dental Clinic

1. Introduction
2. Preparedness for an Emergency
3. Precautions Against an Emergency
4. Management During an Emergency
5. Management of Common Emergencies in Dental Clinic
 - Acute asthmatic attack
 - Hypersensitivity reactions
 - Foreign body obstruction
 - Local anesthesia overdosage
 - Acute adrenal insufficiency
 - Seizures
 - Syncope
 - Hypoglycemia



INTRODUCTION

Life-threatening emergencies are the least wanted and the most dreaded phrase in dental practice. It is very important to possess accurate knowledge about these emergencies and the methods to tackle them.

Some of the common emergencies encountered in the dental clinic while treating a child patient are as follows:

1. Acute asthmatic attack
2. Hypersensitivity reactions
3. Foreign body obstruction
4. Local anesthesia overdose
5. Acute adrenal insufficiency
6. Seizures
7. Syncope
8. Hypoglycemia

Let us first consider some of the necessary preparations required to handle an emergency situation and they are as follows:

1. Preparedness for an emergency
2. Precautions against an emergency
3. Management during an emergency

PREPAREDNESS FOR AN EMERGENCY

It is always wise to be prepared and accept that an emergency is a real possibility in dental practice. For this one has to equip oneself and the dental office.

Equipping Himself

- The practicing clinician and his staff should be up to date in delivering basic life support (BLS) care to sustain the child till emergency medical service arrives.
- A thorough understanding of the pharmacology of important emergency drugs, their dosage during emergencies and the preferred route of administration during emergencies is very essential.
- It is also very important to learn and practice how to administer drugs via the desired parenteral route i.e. SC, IM or IV.

- Investing in emergency equipment without knowing how to use them is unwise. So learning to operate emergency equipment like the oxygen cylinder is of paramount importance.

Equipping the Office

The emergency equipment and drugs required in a pediatric dental setup varies depending on the expertise and the training undergone by the clinician. But, some equipment and drugs are indispensable in pediatric dental practice.

These include:

- A dental chair which can easily be changed into Trendelenburg position.
- A high volume suction to clear oral secretions.
- An oxygen cylinder attached to a face mask capable of delivering 5 L/min for at least 1 hour (Fig. 31.1).
- Ambu bag for positive pressure ventilation (Fig. 31.2).
- Spirit of ammonia
- Adrenaline (1:1000) — for severe immediate allergic and severe asthmatic reactions.
- Diphenhydramine — for allergic reactions of slower onset.
- Hydrocortisone sodium succinate — to treat acute adrenal insufficiency.
- Medihaler — a inhaler medicated with metaproterenol/albutarol for asthmatic attacks
- Diazepam — for continuous epileptic seizures (Status Epilepticus).
- Flumazenil — for reversal of sedation induced by benzodiazepines.
- Nitroglycerin — a vasodilator to treat angina.
- A sugar source — in cases of hypoglycemia.
- Dextrose 50% — for unconscious hypoglycemic patients to be given IV.
- Glucagon — for unconscious hypoglycemic patients to be given IM when IV access cannot be established.



- Prearranged emergency medical service which can be called on short notice.



Fig. 31.1: Ambu bag with mask



Fig. 31.2: Ambu bag connected to oxygen cylinder

medical history is recorded. Based on their medical history, a child is grouped into their respective ASA category which is as follows:

- ASA I: A normal healthy patient without systemic disease.
 - ASA II: A patient with mild systemic disease.
 - ASA III: A patient with severe systemic disease that limits activity but is not incapacitating.
 - ASA IV: A patient with an incapacitating systemic disease that is a constant threat to life.
 - ASA V: A moribund patient not expected to survive 24 hours with or without an operation.
 - ASA E: Emergency operation of any variety, with E preceding the number to indicate the patient's physical status.
- (Children grouped under ASA V and E should not be treated as outpatient and should be under continuous medical care).

This alerts the clinician to the possibility of an emergency (as in ASA II, III or IV) and can prepare in advance for the same or do the treatment in a hospital setting.

Recording Physical Signs

- A baseline blood pressure, pulse rate and respiratory rate must be recorded for all children or at least those belonging to ASA II, III and IV categories.
- The weight of every child should also be recorded. This will help calculate the dosage of the emergency drug to be given.

Careful Use of Drugs

- Drugs especially local anesthetics and sedatives should be used in the correct dosage calculated based on the weight of the child and following the proper protocol.
- Local anesthetics should be administered very slowly at the rate of 1ml/min.

PRECAUTIONS AGAINST AN EMERGENCY

With the emergency training and equipment now in order, a few precautionary steps taken for every child coming for treatment significantly reduces the chances of an emergency. These include:

- a. Recording ASA Classification for the child
- b. Recording physical signs
- c. Careful use of drugs.

Recording ASA Classification for the Child

The American Society of Anesthesiologists proposed a classification indicating the systemic status of a patient. For every child to undergo treatment, a systematic

MANAGEMENT DURING AN EMERGENCY

In spite of all the precautions, life-threatening emergencies do occur and most often happens when least expected.



The role of a dental surgeon is to sustain the patient with basic life support (BLS) and treat the physical signs till the patient is stable or till he can be shifted to an emergency medical center.

The golden rule while managing an emergency is to start by assessing and maintaining Basic Life Support (BLS) and Cardio Pulmonary Resuscitation (CPR) through PABC (Position, Airway, Breathing and Circulation).

P- Position of the patient on the dental chair.

A- Airway should be open and patent.

B- Breathing should be maintained, i.e. sufficient oxygen should be reaching the patient's lungs.

C- Circulation of blood in carotid artery is assessed to see if the heart is beating and adequately perfusing the brain.

D- Definitive therapy is initiated - It includes use of drugs depending on the physical signs and the presenting emergency situation and is done most of the situations by medical personnel.

PABC Assessment and Management (BLS/CPR)

P: Position

Any clinical management of a medical emergency on the dental chair calls for a stoppage in the dental procedure. This has to be followed by proper positioning of the child. There are primarily three positions during an emergency.

1. Supine (Horizontal) position with the brain at the same level as the heart and the feet elevated slightly (Fig. 31.3).



Fig. 31.3: Supine position with legs elevated

2. Head low position: This position is used during unconsciousness or impending unconsciousness. The head down or the Trendelenburg position should be avoided in case of respiratory distress because gravity pushes the abdominal viscera into the diaphragm reducing the effectiveness of breathing.
3. Erect/semi supine position: This position is used in case of signs of respiratory distress. This position makes it easier for the child to breathe.

A: Airway

The idea is to obtain a patent and open airway so that enough oxygen reaches the lungs. First, all the secretions in the oral cavity are cleared using a high volume suction. If the patient is conscious, proceed to the next step, that is to assess breathing.

If the patient is unconscious, the tongue tends to fall back and block the airway. The airway can be opened using the head tilt-chin lift maneuver (Fig. 31.4). The jaw thrust maneuver can also be used to open the airway. It is especially useful in cases of cervical spine injuries seen during road traffic accidents.

In case of foreign body obstruction, the airway has to be cleared using back blows or Heimlich maneuver which will be described later in the chapter.



Fig. 31.4: Jaw thrust maneuver

B: Breathing

First, 'Look Listen Feel' is done. Here, the operator keeps his ears 1 inch away from the child's nose and listens



and feels the breath sounds. At the same time he observes the child's chest for its rise and fall (Fig. 31.5). The listening and feeling of the breath sounds is more crucial than observing the rise and fall of the chest because the child may only be trying to breathe without adequate ventilation.



Fig. 31.5: The operators position for 'Look, Listen and Feel'

If the child is conscious and is breathing adequately, then monitor the vital signs and administer supplemental oxygen if required.

If the child is unconscious, but is breathing adequately then administer supplemental oxygen if required with the head tilt - chin lift to ensure open airway. Monitor the vital signs and proceed to assess C- Circulation.

If the child is not breathing or is breathing inadequately as established from "Look Listen Feel", then administer oxygen under positive pressure or assist ventilation using a well fitting ambu bag. The ambu bag can also be connected to an oxygen cylinder for delivery of 100% oxygen. Give two full ventilations with the ambu bag with the head tilted for an open airway (Fig. 31.6) before proceeding to assess circulation. The mouth to mouth or mouth to nose techniques are not described because it is expected that every dental practice will be equipped at least with an ambu bag. Other advantages of an ambu bag are that it delivers 21% oxygen compared with 18% oxygen using the manual techniques. The ambu bag is also much more hygienic compared to the manual techniques.



Figs 31.6A and B: Note the position of the head and the chin during ventilation; A: Incorrect method; B: Correct method

C: Circulation

The purpose of assessing circulation is to ensure that the heart is beating and enough oxygenated blood is reaching the vital organs especially the brain. This is especially crucial in the child as the child is prone to hypoxia very quickly because of its higher respiratory rate and higher BMR.

The best way to assess circulation in an emergency is to palpate the carotid artery because the carotid artery is easy to locate and it is the artery supplying blood to the brain. The carotid artery is palpated between the Adams apple and the sternocleidomastoid muscle (Fig. 31.7). Two important points are to be remembered. The carotid artery should always be assessed on one



side only because occluding both the arteries may further reduce the blood supply to the brain. The second point that should be remembered is that the thumb should not be used to palpate because the thumb has a pulsating artery of its own and this can be mistaken for the child's carotid pulse.



Fig. 31.7: Note the position of the fingers during carotid artery palpation

If the carotid pulse is felt, then airway and breathing are maintained and the vital signs are monitored. Definitive therapy is started if required.

If the carotid pulse is not felt, then external cardiac compression is started immediately. Shift the child to a hard surface or if the place in the clinic is inadequate, place a hard board under the back of the child on the dental chair.

The anatomic area for compression is the mid nipple line. The operator has to keep his arms locked straight, place the heel of one hand over the mid nipple line and lock it with the other hand. Now the chest is compressed firmly at the rate of 70-80 compressions/minute. For every 15 compressions 2 ventilations are given (15:2) in case of two rescuers. In case the dentist is alone the ratio is 5:1. Continue this cycle till the child is shifted to an emergency.



Fig. 31.8: Carotid compressions for a child less than 7 years. Note the heel of one hand is used

For children less than 7 years old only the heel of one hand is used for compression (Fig. 31.8).

It should be noted in the preceding paragraphs that assessment and maintenance of ABC (Airway, Breathing and Circulation) differs between the conscious and the unconscious child. Definitive therapy is started once the basic life support is maintained and stabilized.

In summary, the management of any emergency should comprise the following steps:

- Note the physical signs occurring at the time.
- Check the medical history of the child to see if the presenting emergency is due to a underlying medical condition.
- Assess PABC according to the individual situation.
- Start definitive therapy (D)

THE MANAGEMENT FOR SOME OF THE EMERGENCIES ENCOUNTERED IN THE PEDIATRIC DENTAL CLINIC

Acute Asthmatic Attack

The goal of management during an acute asthmatic episode on the dental chair should be to relieve the bronchospasm associated with the attack.



Physical Signs and Symptoms

- Child complains of a thickness or heaviness in the chest.
- Followed by a coughing spell with or without sputum production.
- Characteristic expiratory wheeze is heard.
- Dyspnea (labored breathing using accessory muscles of respiration like sternocleidomastoid and scalenus to lift the entire rib cage).
- Sits up fighting for air.
- Tachypnea (very rapid respiration).
- Very anxious child
- Cyanosis of mucous membrane and nailbeds will follow.
- Eventual loss of consciousness if not managed.

PABC Assessment

- Position (P) the child erect /semierect as supine position will make him more breathless.
- Child is usually conscious and breathing with a partially obstructed airway. Clear all dental materials and secretions from the oral cavity so that Airway (A) is not further blocked. Assess Breathing (B) and circulation (C) quickly according to the presenting situation.

Check ASA Category

- Most asthmatics are aware of their condition and give a positive history. They generally carry an inhaler containing a bronchodilator.
- Child would have been classified under ASA category II or III at the end of medical history thus already having alerted the clinician to the possibility of an attack.

Definitive therapy

- 2 puffs of Salbutamol containing 100 µgm/puff through an inhaler.
- The child can also use his own bronchodilator.
- Administration of 100% oxygen.
- If the physical signs and symptoms are not relieved, dial medical assistance and in the meanwhile administer 0.3 ml of 1:1000 adrenaline SC or IM.

Hypersensitivity Reactions

Of the four basic types of hypersensitivity reactions, hypersensitivity reaction is of particular importance in the practice of dentistry. Type 1 or immediate hypersensitivity may range from mild skin reactions to life-threatening generalized anaphylaxis. The speed with which the signs and symptoms of allergy appear and the rate of progressive involvement of systems determines the intensity of management.

The various clinical manifestations of Type 1 or immediate hypersensitivity reactions include:

Delayed Onset Skin Reaction

These signs appear after 60 minutes or more have elapsed since the introduction of the antigenic stimuli most likely the administration of the drug.

Physical signs and symptoms

- Localized areas of erythema.
- Urticaria, i.e. elevated areas of skin which are erythematous, indurated and frequently pruritic.
- Angioedema (Swollen tissue)

PABC assessment

- Since the patient is not in distress except slight itching, position of the child is based on comfort if the signs appear in the midst of treatment.
- ABC is quickly assessed. Generally, at this juncture ABC is adequately maintained by the child.

Check ASA status

- Would most likely be ASA I in the absence of any other significant medical history. Positive histories of allergic adverse drug reactions (ADR) especially to local anesthetics may not always be reliable as the patient may have actually experienced syncope or an overdosage reaction.

Definitive therapy

- Diphenhydramine 25 mg, IM or Chlorpheniramine 5 mg, IM is the dosage for children.



- This has to be followed by Oral Diphenhydramine 25 mg or Oral Chlorphenaramine 5 mg, every 4-6 hours for 2-3 days.

Rapid Onset Skin Reaction

The signs appear less than 60 min after the introduction of the antigenic stimuli. Although these skin reactions are not in themselves dangerous, they may be the first indication of more serious manifestations to follow.

Physical signs and symptoms, PABC assessment and ASA status

- Similar to delayed skin reactions.

Definitive therapy

- It is same as above. But, in this case the child has to be kept under observation for at least an hour to see if signs of respiratory and cardiovascular system involvement appear in which case adrenaline administration becomes essential as will be described in the subsequent section.
- Child should also be sent for a medical evaluation to ascertain the cause of the reaction.

Respiratory Signs With or Without Skin Signs

The respiratory signs may be a sequel to the skin signs or may occur independently. Allergic reactions affecting the respiratory tract are more serious and require more aggressive intervention.

The allergic reactions of the respiratory tract can manifest in two ways either independently or progressively, i.e.

- *Bronchospasm*- affecting the lower respiratory tract.
- *Laryngeal edema*- affecting the upper respiratory tract.

Bronchospasm: Signs and symptoms are due to constriction of bronchial smooth muscle and similar to an asthmatic attack.

Physical signs and symptoms

- Wheezing
- Dyspnea
- Use of accessory muscles of respiration.

PABC assessment

- Position child in an upright or semi-erect position.
- Clear all the secretions and materials from the oral cavity.
- Breathing may be inadequate and may range from mild dyspnea to cyanosis. Administer oxygen 6 liters/minute.
- Circulation is usually adequate at this juncture.

Check ASA status

- The child would have been classified ASA I in the absence of any other significant medical history especially asthma.
- The diagnosis of an allergic reaction over asthma will be established if the respiratory signs are preceded by the skin reaction. In any case, epinephrine will be the drug of choice to relieve the Bronchospasm.

Definitive therapy

- Dial emergency medical assistance.
- Administer 0.15 ml, 1:1000 epinephrine IM/SC. Repeat after 5 minutes if signs progress because epinephrine gets metabolized quickly..
- Monitor vital signs.
- Administer Diphenhydramine, 2 mg/kg, IM to prevent recurrence.
- Observe in office for one hour or hospitalize for further observation.
- Prescribe oral antihistamines, i.e. Oral Diphenhydramine 25 mg or Oral Chlorphenaramine 5 mg, every 4-6 hours for 2-3 days.

Laryngeal Edema

Involvement of the larger airways in an allergic reaction usually first manifest at the most narrow portion of the air passage, i.e. the larynx. The signs and symptoms are due to angioedema of the vocal cords causing partial or total airway obstruction.

Physical signs and symptoms

- Characteristic high pitched crowing sounds (Stridor) in cases of partial obstruction or no sound in cases of total obstruction even in the cases of exaggerated chest movements.



- Cyanosis
- Loss of consciousness if not managed.

PABC assessment

- Position child in an upright or semi-erect position.
- Clear all the secretions and materials from the oral cavity.
- Obtain patent airway by head tilt- chin lift maneuver.
- Breathing will be labored. Administer oxygen 6 liters/minute.
- Quickly assess circulation.

Check ASA status

- The child would have been classified ASA I in the absence of any other significant medical history.

Definitive therapy

- Dial emergency medical assistance.
- Administer 0.15 ml, 1:1000 epinephrine IM. Repeat after 5 minutes if signs progress.
- Monitor vital signs.
- If laryngospasm is not still relieved, an emergency cricothyrotomy may have to be performed. The technique of cricothyrotomy is beyond the scope of the chapter.
- On clinical recovery with administration of epinephrine (noted as improved breath sounds, absence of cyanosis and less exaggerated chest movements) administer Diphenhydramine, 2 mg/kg, IM and corticosteroid 100 mg IM.
- Corticosteroids inhibit edema and capillary dilatation by stabilizing the basement membrane.
- These additional drugs are not administered during the emergency because they are of no immediate value as their onset of action is slow.
- It is wise to hospitalize the patient after such a severe attack.

Generalized Anaphylaxis

This life-threatening reaction occurs within seconds or minutes following parenteral administration. A wide range of clinical manifestations involving multiple systems quickly progressing from skin reactions, gastrointestinal

manifestations and respiratory distress followed by signs and symptoms of the cardiovascular system like hypotension, unconsciousness finally cardiac arrest.

Physical signs and symptoms

- Typically begins with the patient complaining of a feeling of impending doom.
- Skin manifestations like urticaria, erythema and pruritus appear on the face and the trunk.
- Nausea, vomiting, abdominal cramping and urinary incontinence may appear.
- Symptoms of respiratory embarrassment follow with dyspnea, wheezing and stridor.
- Cyanosis of nailbeds and mucosa is seen.
- Disordered CVS function manifests as tachycardia and palpitations.
- The patient becomes unconsciousness.
- Cardiac arrest follows if not managed immediately.

PABC assessment

- Position patient supine with legs elevated on a back board on the dental chair or shift the patient on to the floor.
- A hard surface is necessary for external cardiac compression in case of a cardiac arrest.
- Open the airway with head tilt-chin lift.
- Ask the assistant to prepare the oxygen cylinder while the doctor quickly progresses to definitive therapy.
- Generalized anaphylaxis is the only emergency where priority to drug administration of epinephrine is given over the usual sequence of PABC because epinephrine can be life saving in this situation.
- Oxygen, 5-6 liters/minute can be administered any time during the incident.

Check ASA status

- The child would have been classified ASA I in the absence of any other significant medical history.

Definitive therapy

- Dial emergency medical care.
- Administer 0.15 ml, 1:1000 epinephrine IM preferably from a preloaded syringe because time is crucial here.



- Epinephrine can be injected sublingually to the floor of the mouth because of the increased perfusion in the area.
- Repeat after 5 minutes if the clinical picture fails to improve.
- Monitor vital signs. Record blood pressure and heart rate at the carotid artery every 5 minutes.
- Start chest compression if cardiac arrest occurs.
- Once and if clinical improvement is noticed, i.e. increased BP, decreased bronchospasm and return of consciousness, administer Diphenhydramine and corticosteroids IM to prevent recurrence.
- Hospitalize the patient for further observation.

Foreign Body Obstruction

The extensive use of stainless steel crowns, endodontic instruments, conscious sedation and the small oral cavity of the child are factors which make foreign body obstruction a potential problem in the practice of pediatric dentistry.

When an object is lost in the oropharynx, the chances are high that the child will either swallow the object into the esophagus or the object will be retrieved by spontaneous coughing. The object may also be small, thereby bypassing the larynx into the trachea and the right bronchus. In these cases, no signs and symptoms of respiratory obstruction appear. Chest radiographs are taken to determine the location of the foreign object.

If the object on the radiograph is seen in the abdomen, it passes uneventfully from the stomach and the intestines through the fecal matter more than 90% of the time. Parents should be asked to locate the object in the fecal matter over the next couple of days. Potential complications can be GI blockage, peritoneal abscess and intestinal perforations.

If the object on the radiograph is seen in the bronchus, then the object has to be removed by the medical specialist using bronchoscopy.

Airway obstruction by the object can be complete or partial.

Partial Airway Obstruction

Physical signs and symptoms

- Child will reflexly cough forcefully.

- Wheezing may be seen between coughs.
- Child is able to breathe, though with some difficulty.
- No signs of cyanosis appear.

PABC assessment and management

- In case of partial airway obstruction as judged by the presenting signs and symptoms, the child should be positioned (P) in a left lateral decubitus position with the head down (Fig. 31.9). The child will cough spontaneously which may adequate to throw out the aspirated object and clear the airway (A). Once a patent airway is obtained the signs and symptoms cease on their own.



Fig. 31.9: Left lateral decubitus position

Total Airway Obstruction

Physical signs and symptoms

- Patient grasps the throat (Universal sign of choke)
- Inability to speak
- Inability to cough
- Inability to exchange air in spite of respiratory movements
- Cyanosis
- Loss of consciousness if not managed
- Cardiac arrest finally.

PABC assessment and management

The management differs depending on if the child is conscious or unconscious. The goal is to remove the foreign body from the airway. Once a clear and patent airway is obtained, the other signs and symptoms cease on their own.

i. Conscious child

The abdominal thrust or the *Heimlich* maneuver is used to expel the foreign body. It acts like an artificial cough



that produces a rapid increase in intrathoracic pressure thus helping expel the foreign body (Fig. 31.10). It is done as follows:

- Stand behind the child and wrap under the child's arms.
- Place fist slightly above the umbilicus with the thumb side against the abdomen.
- Grasp the fist with the free hand.
- Thrust inwards and backwards repeatedly till the foreign body is expelled or till the child loses consciousness.



Fig. 31.10: Heimlich maneuver in a conscious child

ii. Unconscious child (Fig. 31.11)

- Put the child in the Trendelenburg position (P).
- Open airway (A) by head tilt-chin lift.
- Stand next to the child's hips.
- Place heel of one hand slightly above umbilicus, but below the xiphoid. Place second hand on top of the first hand.
- Perform five thrusts in an inward and upwards direction.
- This should be followed by a finger sweep in the child's mouth. The idea of a finger sweep is to move the dislodged object into the mouth.
- If the foreign object is still not dislodged and the patient's condition continues to deteriorate, then a surgical procedure called cricothyrotomy should be considered. This requires proper training and is beyond the scope of this chapter.



Fig. 31.11: Heimlich maneuver in an unconscious child

Local Anesthesia (LA) Overdosage

Local anesthetics are the most commonly used drugs in dentistry. Their overdosage is caused by a high blood level of the drug when the drug's entry into the blood exceeds its rate of removal. Most of the LA overdose reactions are self-limiting. The blood level of the drug decreases continuously because of redistribution and biotransformation of the drug in the body. Maintenance of ABC and oxygen are probably the only measures indicated.

Simple measures to prevent an LA overdose reaction are:

- Calculating the proper dose for each individual (for example, 4.4 mg/kg body weight for 2% Lidocaine with 1:100,000 adrenaline).
- Aspiration before injecting
- Slow rate of injection (1ml/minute)
- Proper systemic history. For example, patients with congestive cardiac failure are more prone to overdose reactions because of a reduced blood volume for drug distribution and reduced blood flow to the liver secondary to a reduced cardiac output. The amount of LA given should be reduced for this patient.

The LA overdose reactions can be mild reactions or severe reactions depending on the rate of absorption



of the drug and the blood level of the drug. Clinically LA overdose reactions are manifested depending on the severity as a phase of excitation (Slurred speech, confusion, convulsions) followed by a proportional phase of depression (drowsiness, shallow breathing, unconsciousness).

Mild Overdosage Reaction

Mild overdosage reaction of rapid onset is seen within 5-10 minutes of administration. The causes can be intravascular injection or administration of a large dose.

Physical signs and symptoms

- Confused, talkative.
- Slurred speech
- Ringing ears
- Facial muscle twitching
- Blurred vision
- Dizziness

PABC assessment and management

- Position (P) is based on patient comfort usually supine.
- ABC is usually adequate. A lower PaCO_2 elevates the seizure threshold. So the patient should be asked to hyperventilate by deep breathing of room air or breathe oxygen via a full face mask. This will decrease the PaCO_2 thus preventing the development of seizures.

Check ASA status

- Patient would have been classified under ASA category I in the absence of other systemic conditions. It should be noted that some conditions like congestive cardiac failure and pulmonary diseases (show increase in PaCO_2) are more prone to LA overdosage reactions.

Definitive Therapy

- Monitor the vital signs. No other drug treatment is indicated. The reactions are self-limiting with time. Mild LA overdose reactions can also have a late onset usually above 10 minutes after administration. The

management of these reactions is essentially the same as above.

Severe Overdose Reaction

Severe overdose reaction of rapid onset is usually manifested seconds after LA administration. It sometimes occurs during the process of injection. Intravascular injection is the likely cause.

Physical signs and symptoms

- Signs and symptoms appearing almost immediately.
- Generalized tonic clonic seizures.
- Loss of consciousness.

PABC assessment and management

- Shift the patient to supine position with legs elevated.
- Assess ABC quickly. Administer oxygen as quickly as possible. The seizure threshold is lowered if the patient becomes acidotic. Good ventilation helps in termination of the seizure along with adequate oxygenation of the brain.

Check ASA status

- Patient would have been classified under ASA category I in the absence of other systemic conditions. Check if any previous episodes of seizures have been noted in the systemic history. It should be noted that some conditions like congestive cardiac failure and pulmonary diseases (show increase in PaCO_2) are more prone to LA overdosage reactions.

Definitive therapy

- If loss of consciousness was the only sign, proper positioning will return consciousness rapidly and syncope was probably the cause.
- If patient does not regain consciousness after adequate positioning or if seizure develops immediately after LA administration, then dial emergency medical care as a precautionary measure.
- Monitoring vital signs with adequate ventilation is usually sufficient because anesthetic blood level will gradually fall below the seizure threshold and seizures



will cease. Prevention of injury due to seizures is the primary aim of seizure management.

- Drug administration like diazepam for seizure management during LA overdose reactions is unnecessary in most cases because the period of excitement will be followed by a period of depression (Shallow breathing, hypotension, bradycardia, drowsiness and loss of consciousness). This phase of depression will be magnified by the administration of a depressant drug like diazepam.
- Generally adequate maintenance of PABC will gradually return the consciousness and BP/heart rate return to base line levels.

Severe LA overdose reactions can also have a late onset usually above 10 minutes after administration. If manifestations appear at home, the patient should be shifted to a hospital immediately and instructions given to the hospital staff. The management of these late onset reactions is essentially the same as above.

Acute Adrenal Insufficiency

This condition can manifest in children receiving or who have received corticosteroid therapy continuously for two weeks or longer. In these children, normal release of increased amounts of endogenous glucocorticosteroids during stressful situations is prevented resulting in an acute adrenal attack.

Physical Signs and Symptoms

- Mental confusion.
- Intense pain in the abdomen, lower back and legs.
- Nausea and vomiting.
- Loss of consciousness if not managed.

PABC Assessment

- Place child in supine position with legs elevated slightly.
- Assess ABC quickly. Administer oxygen.

Check ASA Category

- Parents would have given a positive history of corticosteroid therapy satisfying the rule of twos.

- Child would have been classified under ASA category II or III at the end of medical history thus already having alerted the clinician to the possibility of an attack.

Definitive Therapy

- Dial medical assistance.
- Administer 2 ml of 100 mg hydrocortisone sodium succinate IV preferably or IM.
- Monitor vital signs especially for hypotension.

Seizures

Among the various types of seizures (convulsions), the one with the most dramatic appearance is a generalized form of epilepsy called the generalized tonic clonic seizure (grand mal epilepsy) and will be discussed here. These seizures are not life-threatening as is commonly believed. They are self-limiting in most cases and prevention of injury and adequate ventilation are of primary concern. Drugs are generally not indicated. Only if the Generalized Tonic-Clonic Seizure (GTCS) persists for more than 5 minutes continuously, then the condition is called Status Epilepticus which is a serious condition requiring immediate IV administration of an anticonvulsant.

Presenting Signs and Symptoms

- Aura is a typical sign exhibited by each individual minutes before an attack. It may be manifested as increased anxiety or depression. The patient cannot warn the dentist about the aura because he has already become amnesic at the onset of this stage. If a friend or a relative notices this typical aura during dental treatment, he should warn the dentist and treatment should be stopped immediately.
- This is followed by a loss of consciousness. This is called as the preictal phase, i.e. the phase before convulsions.
- This is followed by the tonic-clonic convulsions. It is called as the ictal phase. It lasts for about 2-5 minutes.



- Bleeding from the mouth and frothing may be seen in the ictal stage.
- This is followed by the post-ictal phase where the tonic-clonic movements cease and consciousness gradually returns.
- Urinary or fecal incontinence may occur in the post-ictal phase because of sphincter relaxation.

PABC Assessment and Management

- On warning of the aura, cease treatment and position (P) patient in the supine position.
- Remove all dental equipment and appliances from the mouth of the patient before loss of consciousness.
- Maintain airway (A) by head tilt-chin lift on the headrest of the dental chair. Also suction the secretions by placing a flexible suction between the cheek and teeth.
- Administer oxygen if possible to aid in breathing (B). Circulation is usually adequate.

Check Medical History

- Check the patient's systemic history to see if the patient has a history of epilepsy or any other condition like diabetes which manifests convulsions during a hypoglycemic attack.
- The patient would have categorized as ASA II if he had a previous history of seizures, ASA III if seizures occur once a month and ASA IV if seizures are seen weekly.

Definitive Therapy

- Prevention of injury to the patient is the primary goal.
- Remove instruments like handpieces, burs and other instruments from the vicinity of the patient.
- Loosen clothes to aid in breathing.
- Gently restrain the patient's extremities allowing for minor movement. Care should be taken not to fix the extremities during convulsions as this may result in fractures.
- The ictal phase may last upto 5 minutes.
- With cessation of seizures, a period of generalized depression sets in. PABC is maintained along with

oxygen administration. Vital signs are monitored and the patient is reassured.

- Should the seizures continue after 5 minutes or appear at very short intervals then the condition is serious and is called status epilepticus.
- In this case dial medical assistance. The dentist can administer an anticonvulsant like diazepam (0.3 mg/kg) IV slowly if trained. If not maintain basic life support till patient is shifted or till emergency medical help arrives.

Syncope

It is a benign and self-limiting common faint, but potentially life-threatening if not managed properly. It refers to a sudden transient loss of consciousness secondary to a period of cerebral ischemia. Children very rarely manifest syncope because they do not hide their fears. They yell and cry and move about thus increasing the cerebral blood flow.

Simple ways of preventing syncope are:

- Do not wave needle in front of the patient.
- Administer LA in supine position.
- See that the clinic is not hot and humid.
- Check that patient is not on an empty stomach.
- Use mild sedatives if required.

Physical Signs and Symptoms

- Pale color
- Heavy perspiration primarily on the forehead
- Dizziness
- Nausea
- Hyperpnea
- Cold hands and feet
- Loss of consciousness with pupillary dilatation (deathly appearance).

The individual thus exhibits several warning symptoms for several minutes (Pre-syncope) before losing consciousness.

PABC Assessment and Management

- P: As soon as presyncopal signs appear, patient is placed in supine position with legs elevated. Patient



can also be encouraged to vigorously move his legs so that muscles can pump blood back into the heart.

- If the patient has already lost consciousness, the ABC should be assessed and maintained.
 - A: Maintain airway by head tilt-chin lift
 - B: Look, Listen and Feel for breathing. Administer oxygen if necessary.
 - C: Check the carotid pulse. The carotid pulse may be weak during the syncope period.

Check ASA Status

- The child would have been classified ASA I in the absence of any other significant medical history.

Definitive therapy

- Monitor vital signs.
- Loosen clothing and belt.
- A respiratory stimulant like spirit of ammonia can be helpful because it stimulates breathing and muscular movement as it has a noxious odour.
- A cold towel can be placed on the patient's forehead.
- A glucose drink can be given after consciousness is regained.
- Medical assistance is rarely required because consciousness rapidly returns on proper positioning.

Hypoglycemia

Hypoglycemic attack is seen in a diabetic patient undergoing dental treatment. Diabetes mellitus can be type I, i.e. insulin dependent diabetes mellitus (IDDM) or type II, i.e. NIDDM. Type I is genetic. Here insulin is totally absent and the patient requires exogenous insulin for glucose metabolism. In type II, insulin in the body may be adequate but the receptors in the tissues may be insensitive to the insulin.

Dental treatment modifications are required more with a type I diabetes patient. He may miss or avoid a meal before his dental appointment after taking his usual dose of insulin resulting in a hypoglycemic attack. The patient should be asked to take his usual dose of insulin along with his normal meal before the appointment. If the daily insulin dose of the patient is i.e. > 40 units daily, then a medical consultation should

be arranged before the dental appointment. Antibiotic coverage is also recommended for such patients before undergoing surgical procedures. The type II diabetic patient is less prone to acute fluctuations in blood glucose level and generally tolerates all dental procedures well.

Any known diabetic who has become unconscious should be treated for hypoglycemia rather than hyperglycemia because hypoglycemia can rapidly result in serious neurologic damage or death if not treated immediately. In contrast complications from hyperglycemia tend to develop over a long period of time.

Presenting Signs and Symptoms

- Weakness
- Dizziness
- Moist skin
- Altered level of consciousness, i.e. bizarre behavior or changes in personality.
- Loss of consciousness and GTCS if not managed.

Conscious Patient

PABC assessment and management:

- Position (P) is determined by patient comfort.
- ABC is assessed. Generally adequate at this stage.

Check medical history:

- The patient would have generally given a positive history of diabetes. The patient would have been classified as ASA II, III or IV depending on the blood glucose level and depending on whether he is a well controlled or poorly controlled diabetic. If the patient is a ASA I, syncope can be a possible reason and proper positioning should lead to rapid recovery.

Definitive therapy

- Give the patient an oral carbohydrate like orange juice, sugar or a candy. It should be repeated every 5 minutes till recovery.

Unconscious Patient

PABC assessment and management:

- Position (P) patient in a supine position with legs elevated slightly.



- Assess and maintain ABC. Administer oxygen if necessary. But the underlying problem of low blood sugar has to be corrected for consciousness to be regained.

Check medical history:

The patient would have generally given a positive history of diabetes. The patient would have been classified as ASA II, III or IV.

Definitive therapy:

- Dial emergency medical care.
- Administer Glucagon 1mg IM. Leads to elevation of the blood glucose level by breaking down glycogen stores in the liver. The recovery usually takes 20 – 40 minutes.
- If trained, the dentist can administer 50% dextrose solution IV. If not it can be done by the emergency personnel.
- If glucagon or dextrose is not available immediately, a thick paste of concentrated glucose (cake cream), honey or syrup can be placed in the buccal fold safely. Even though the onset of action is slow, it is better than no treatment.
- Once conscious, the individual is administered oral source of carbohydrates.

In conclusion, a dentist treating children has a moral responsibility towards the overall well being of the child. The dentist has to make efforts to upgrade his knowledge and be fully prepared to face any emergency during the course of the treatment. Only then can he confidently tell the parents that—*Your child is in good hands.*

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